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WATER QUALITY INVENTORY

Environmental Protection Agency

October 1975

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Region VIII

Water Quality Inventory

By

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October 1975

EPA Region VIII LIBRARY
Denver, Colorado

FOREWORD

This Water Quality Inventory and its Water Quality Index based approach is not considered an "end all." It is merely an orderly start from which the analyst can structure his critique and add his assessment. It is not proposed as the official method. In fact, many indexing techniques are available. It is a simple tool which has been useful in assessing the present condition and apparent quality-trends of Region VIII's mainstem watercourses.

COLOR ILLUSTRATIONS REPRODUCED
IN BLACK AND WHITE

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I. Summary.

Of the fifty-two (52) state use segments and eight (8) lakes analyzed with available STORET data a tally of Region VIII projections based on a Water Quality Index approach is as follows:

Unqualified meeting of 1983 goals (sufficient data is available and conditions are not expected to materially change).

12 segments
4 lakes

Probable meeting of 1983 goals (judgement is reserved due to limited breadth of quantitative data and/or some doubt regarding future conditions).

17 segments
3 lakes

Doubtful meeting of 1983 goals (sufficient data is available but the nature of conditions are not amenable to rapid improvement, at least, along some portion of the watercourse).

4 segments
1 lake

Will not meet 1983 goals without year-round flow augmentation

4 segments

Questionable (data is insufficient in quantity and breadth and/or future conditions are not determinable).

15 segments

Trend analysis indicates eleven (11) segments have shown improvement. Eighteen (18) segments and two (2) lakes have maintained the "status quo". Twenty (20) segments, all major lakes; except Carter and Horsetooth Reservoirs, and all groundwater were not "trend-rateable" due to the lack of data. Three (3) segments showed some decline in water quality. (See Table 10 for a segment-by segment breakdown).

State-by-state breakdown of trends indicated:

A. Colorado shows an overall decline in quality due primarily to an increase of nutrient and salinity related violations, primarily, along the South Platte River. Colorado's decline shadows improvements in bacterially related parameters (Bac-T); namely, fecal and total coliform, along both Colorado segments of the Colorado River and the lower Arkansas River and reduced nitrogen violations on the lower segment of the Colorado River and the upper segment of the Arkansas River.

B. Montana shows some improvement due to reduced Bac-T violations on the lower Yellowstone, and Powder Rivers, and some nutrient improvement on the lower Missouri. Trends are somewhat obscured by discontinuance of several stations along the Clark Fork River.

C. North Dakota has shown little apparent change with some D.O., BOD and Bac-T improvements on the Red River of the North, offset to some extent, by a decline in Bac-T quality on the James River.

D. South Dakota aggregate analysis indicates some decline in quality which is largely attributable to increased salinity violations on the Missouri River. Trends are somewhat clouded by the lack of Bac-T data on the Big Sioux River.

E. Utah has shown trends toward improved conditions, with Bac-T improvements in the lower segments of the Jordan and Bear Rivers as well as improved D.O., BOD, and nitrogen conditions on the Weber River. Presence of many D.O. observations in only the second period and lack of violations dampens this apparent statewide improvement.

F. Wyoming trends toward improvement, however, the absence of coliform data at all but North Platte stations disrupts trend analysis. Bac-T and nitrogen related water quality is improving on the North Platte while salinity has seemingly improved somewhat on the Wind-Bighorn River system.

Regionally trends are misshapen by an inequitable distribution of data from state-to-state. Overall each state (with the exception of South Dakota which has very irregular coliform data collection) shows improvement in Bac-T. Dissolved oxygen and BOD violations, are generally infrequent in the region, except along the South Platte and Jordan Rivers. Eutrophication potential, regarding joint abundance of nitrogen and phosphorous, is high; especially for the lower reaches of the lower flow watercourses (mean flow <1000 cfs.). Salinity violations are on the increase especially on the lower regional segments of the South Platte and Missouri Rivers.

Using a case-by-case "severe events" approach for parameters, or conditions, not readily treated as part of the Index it was found that despite limited pesticide data "Blue Book Excesses" of Diazinon and frequent concentrations of 2,4-D above 0.1 μg/l were indicated at numerous locations. DDT and Dieldrin, both under severe use limits, were also frequently observed, but mostly prior to 1973. (At several locations mud samples showed traces of pesticides, however, whole water samples showed none.) Fish kills have seemingly diminished in number but their severity is undeterminable since centralized reporting has not been rigorous since 1972. An in-stream review of Public Health Drinking Water Standards for dissolved constituents not readily treatable by conventional processes showed marginal selenium violations along several Region VIII mainstems especially on the lower Clark Fork River. Sporadic lead, cadmium and pH violations were observed along the Jordan River. Mercury at or near the proposed drinking water standard of 2.0 μg/l at Pembina and Fargo respectively was detected along the Red River of the North. Potentially toxic conditions for aquatic life along many locations were frequently observed. These conditions were due mostly to heavy metals, especially zinc and mercury, and to a lesser extent to copper and lead. Scattered excesses were observed for other parameters such as unionized ammonia but uneven distribution of data obscured these trends. Salinity values at twice the recommended PHS standard, although not directly tied to 1983 goals; but clearly to full usefulness, has noted numerous and often severe excesses along some watercourses. Few temperature or pH problems were routinely observed, however, intense interest should be given to those areas that did highlight temperature problems, especially those below several major dams and others along low-flow watercourses. pH problems due possibly to eutrophic conditions or acid mine drainage should also be closely scrutinized.

Violations of oxygen related and bacterial indicators, seem, in this broad overview to be on the wane, however, the South Platte and Jordan Rivers, will still require special abatement efforts for continued improvements since much of the normal flow in these watercourses is attributable to urban uses.

Water Quality Index analysis of important intraregional-interstate watercourses, namely the Missouri, Colorado, Bighorn, Green and James Rivers indicates some decline in quality as they cross the Region. Although still in the excellent category the lower reaches of Missouri, Bighorn and Green Rivers show some decline. Much diminished quality is seen on the Colorado River as it crosses the Region. The James River is degraded for almost its entire regional length.

Assessment of available trend data on important international watercourses manifests low-flow related problems on the Souris River and despite significant point source improvements, the unexplained presence of heavy metals along the Red River of the North.

II. Introduction.

Trends were analyzed using an Index tailored to the kinds and characteristics of data available in STORET for Region VIII. Basis for the Index was violation of state standards. Four groups were considered for the Index:

1. DO & BOD
2. Total & Fecal Coliform
3. Nitrogen - Phosphorous
4. Salinity and Aesthetics Related

Each group was given equal weighting and mathematically arranged to provide a value from 1 to 100. A minimum of six values per group was required for rateability. By employing a "product of the groups" approach the Index was made conservative and all four groups would collectively need to be bad for a high or bad rating to result.

This Index has attempted to look at macro rather than micro trends: if accessable, for a 5-year period from July 1969 thru June 1974. To provide a 6-year trend and to avoid uneven distribution of seasonal coverage the data period was split with a one year overlap to cover July 1969 thru June 1972 and July 1971 thru 1974.

For organizational purposes, a mainstem or hydrologic summary approach was employed for key rivers selected after careful consideration of intrastate, interstate, and international significance. Each river was broken down to state use segments. Station selection was restricted to STORET "data rich" (see Appendix 1) stations; data rich as of 1 April 1974.

Using this data-rich approach very few lakes were indexable and the few data-rich groundwater stations that were found were considered inadequate for any aquifer type trend analysis. Essentially, then, except for limited lake coverage this review is an evaluation of certain key flowing mainstem watercourse.

A "severe event" approach was used to reinforce the Index and at the same time to handle the irregular coverage and/or infrequent violations of much of these data. Fish kills, presence of pesticides in water, toxic levels for appropriate indicator fish, U.S. Public Health Drinking Water Standard Violations, salinity greater than 1000 mg/l, pH outside a range of 6 to 9, and state temperature violations were considered "severe events".

Criteria used for toxic levels for indicator fish came entirely from EPA's "Water Quality Criteria - 1972" (Blue Book). Eutrophic conditions were assessed using modified Sawyer numbers recommended by the EPA's Eutrophication laboratory at Corvallis, Oregon. The Public Health Service's "Drinking Water Standards - 1962" were used for pH violations. State standards were used, if quantified, for each segment.

If state standards were more severe than the Blue Book, this value was used. If non-toxic type parameters such as color or total suspended solids were considered by the state in their standards these were included in the aesthetic related sub-group of the Index.

This process should permit assessment of STORET's ability to function as a tool for water quality trend assessment. Additionally, the ability or inability of the available data to permit assessment of the impacts of federal and state water quality management and grant programs should emerge. Concurrently the status of each state's obligation to make their data available to STORET was evaluated. Gaps and duplications in station and parameter coverage should emerge.

Additionally, a measure of performance has been sought with which EPA-Region VIII can evaluate its effectiveness in meeting 1983 goals as shown by an increasing ability of our watercourses to support a balanced fish life and to provide full recreational uses in these waters. It is also hoped that this kind of overview approach will now, or will in the future, complement and amplify a microscopic state analysis and at the same time lend commonality for further analysis.

III. Recommendations.

1. Since this evaluation is a product of the data base in STORET it evaluates the adequacy of this data base to highlight trends. Each state or other data collecting agency should determine if data, either for Index or "severe events" analysis, is available to complement present STORET data. Much data is known to exist outside of STORET such as referenced in each states 305(b) report and 303(e) basin plans. This data should be stored and thereby made available to all users, especially adjoining states, so that better interstate and regional analysis is possible.

2. Data gaps are highlighted by dashed or green colored lines on the "Present Quality" graphic (Figure 2). Every watercourse, with the exception of the Red River of the North and the Jordan River, require additional data. Particularly noteworthy are data needs for Wyoming and Montana. Major lakes and reservoirs all require additional data. Given the limits of available resources the data base should be expanded on an appropriate priority basis to allow better trend analysis. (EPA's National Water Quality Surveillance System Stations, USGS's National Stream Quality Accounting Network as well as State Primary Station Networks are now in operation and should provide much of this needed trend data.)

3. Data needed to determine the impact of grant monies and the NPDES permit program are only incidentially available. Major outlays of time and money should have appropriate data available to permit evaluation of the effectiveness of these efforts.

4. Flow data, at least for primary trend stations, should be collected as part of each monitoring program. In some cases trend stations should be aligned with existing USGS gaging stations and in others either the USGS or the collecting agency should perform flow measurements to coincide with their water quality analysis.

5. Use of the "data-rich" directory should be encouraged. If updated semi-annually, it should be a valuable tool to all data users. This singularly useful summary can be a basic reference for trend and impact assessment, as well as a cross reference for data concentrations and storage.

6. Closer coordination with federal and state "fish" agencies with their counterparts in water quality offices is needed. This needed communication can more directly assess in-stream conditions.

7. Data in STORET should be screened to eliminate, archive, or otherwise remove bad, old or useless data.

8. Good, raw data must always be scrutinzed as part of any interpretive data analysis. Computer aided analysis can only complement the insightful review.

IV. Parameter Selection.

Basic to this overall review are the assumptions made and the parameters selected. Parameters with accompanying baseline values were selected from state standards or in the absence of a state standard from Public Health Service 1962 Standards Criteria, quantified "free froms" using EPA's "Water Quality Criteria - 1972" standards (Blue Book) or "nominal" standards selected by reference to other sources.

Since early in the data review phase a need for editing limits were seen to be necessary to screen out suspect data. Limits were arbitrarily set outside of which data was thought to be erroneous. Data was generally assumed equal regardless of source, although metals data was carefully handled. Coliform analysis using a membrane filter or MPN technique were assumed comparable. TDS results based on drying at 105° or 180° were likewise assumed to be equivalent. Conductivity multiplied by 0.67 was assumed to equate to TDS values. Nutrient violations for dissolved constituents were favored over total N or P. In the absence of dissolved parameters though total N or P was used. Dissolved concentrations were used for all PHS standards violations. Total or dissolved metals were used for toxic analysis.

A breakdown of the parameters reviewed in each group with pertinent data regarding editing limits, standards used for violations assessment and source are given in Table 1.

A complete summary of each states water quality standards is provided in Appendix 4.

Table 1

PARAMETER-BY-PARAMETER REVIEW

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
Index Groups I. Oxygen Related				
I.A. - Dissolved Oxygen				
00300	Dissolved Oxygen	0-20 mg/1	State Std.	State Std.
00299	Dissolved Oxygen	0-20 mg/1	State Std.	"
I.B. - Biochemical Oxygen Demand				
00310	BOD	0-100 mg/1	(5 mg/1-Utah) 10 mg/1	Nominal
II. Bacteria				
II.A. - Total Coliform				
31501	Total Coliform	1-20x10^{6}/100ml	State Std.	Nominal
31503	Total Coliform	" "	"	"
31504	"	" "	"	"
31506	"	<1-20x10^{6} "	"	"
31507	"	" "	"	"
31508	"	" "	"	"
II.B. - Fecal Coliform				
31614	Fecal Coliform	<1-10x10^{6} "	"	"

Table 1

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
II.B. - Fecal Coliform				
31615	Fecal Coliform	$<1\text{-}10\times10^6$/100ml	State Std.	State Std.
31616	"	$1\text{-}10\times10^6$ "	"	"
31617	"	$<1\text{-}10\times10^6$ "	"	"
III. - Nutrients				
III.A. - Nitrogen				
00600	Total Nitrogen	0-50 mg/l	0.6	Corvallis
00618	Dissolved Nitrate-(NO_3) N	" "	"	"
00620	Total NO_3-N	" "	"	"
00630	Total Nitrite/ Nitrate (NO_2/ NO_3-N)	" "	"	"
00631	Dissolved NO_2/ NO_3-N	" "	2.6	"
71850	Total NO_3	" "	"	"
71851	Dissolved NO_3	" "	"	"
71887	Total NO_3	" "	"	"
III.B. - Phosphorous				
00650	Total Phosphate (PO_4)	" "	0.09	"
00653	Dissolved PO_4	" "	"	"

PARA #	BRIEF DESCRIPTION	EDITING LIMITS		STANDARD VALUE	SOURCE
III.B. - Phosphorous					
00660	Ortho PO_4	0-50 mg/1		0.09	Corvallis
00665	Total Phosphorous (P)	" "		0.03	"
00666	Dissolved P	" "		"	"
00671	Dissolved Ortho P	" "		"	"
IV. - Physical/Aesthetic					
IV.A. - Solids Related					
00094	Conductivity	0-375000	µMHO	750 µMHO	PHS x 1.5
00095	"	"	"	" "	" "
00515	Dissolved Solids	0-250,000	mg/1	500 mg/1	PHS x 1.5
70295	" "	"	"	" "	" "
70300	" "	"	"	" "	" "
00940	Chloride	0-100,000	"	250 "	" "
00946	Sulfate	"	"	" "	" "
IV.B. - Aesthetic Related					
00070	Turbidity	0-10,000	JTU	25 JTU	WQC
00950	Dissolved Fluoride	0-20	mg/1	1.6 mg/1	PHS
00951	Total Fluoride	"	"	" "	"
01046	Dissolved Iron	0-10000	ug/1	300 ug/1	WQC
01056	Dissolved Manganese	0-100000	"	50 "	"

Table 1

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
IV.B. - Aesthetic Related				
32005	Carbon Chloroform Extractables	0-100	0.2 mg/l	PHS
32730	Phenols	0-10000 ug/l	1 ug/l	"
38260	MBAS	0-100 mg/l	0.5 mg/l	"
Severe Events Groups				
Physical Modification				
00010	Temperature	0-70°C	State Std.	State Std.
00011	"	0-160°F	"	"
00400	pH	2-10 S.U.	6-9 S.U. Acceptable Range	WQC
00403	"	" "	"	"
Toxic Metals				
01025	Dissolved Cadmium	0-10000 ug/l	0.4 mg/l if hardness <100 mg/l 4 mg/l if hardness >100 mg/l	WQC
01027	Total Cadmium	" "	"	"
01030	Dissolved Chromium	" "	50 ug/l	"
01033	Tri-valent Chromium	" "	"	"
01034	Total Chromium	" "	"	"
01040	Dissolved Copper	" "	20 ug/l	"

Table I

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
Toxic Metals				
01042	Total Copper	0-10000 ug/l	20 ug/l	WQC
01049	Dissolved Lead	" "	30 ug/l	"
01051	Total Lead	" "	"	"
01065	Dissolved Nickel	" "	100 ug/l	"
01067	Total Nickel	" "	"	"
01090	Dissolved Zinc	0-50000 "	30 ug/l	"
01092	Total Zinc	" "	"	"
Toxic Nonmetals				
00299	Dissolved Oxygen	0-20 mg/l	<2.0 mg/l	Nominal
00300	"	" "	"	"
00608	Dissolved Ammonia	0-100 "	0.02 mg/l Adjusted for unionized	WQC
00610	Total Ammonia	" "	"	"
00720	Cyanide	0-10 "	0.005 mg/l	"
00722	Free Cyanide	" "	"	"
00745	Sulfide Total	0-100 "	0.002 mg/l Adjusted for Undissociated	"

Table 1

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
Toxic Nonmetals				
00746	Dissolved Sulfide	0-100 mg/l	0.002 mg/l Adjusted for Undissociated	WQC
50060	Tot. Resd Chlorine	0-20 "	0.003	"
50064	Free Chlorine	" "	"	"
50066	Combined Chlorine	" "	"	"
71845	Nitrogen Ammonia	0-100 "	0.02 mg/l Adjusted for Unionized	"
71875	Hydrogen Sulfide	0-100 "	0.002 mg/l Adjusted for Undissociated	"

Public Health Std. (Finished Water)

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
Metals				
01000	Dissolved Arsenic	0-10000 ug/l	500 ug/l	PHS
01005	Dissolved Barium	0-100000 "	1000 ug/l	"
01025	Dissolved Cadmium	0-10000 "	10 ug/l	"
01032	Hexa-valent Chromium	" "	50 ug/l	"
01049	Dissolved Lead	" "	"	"

Table 1

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
Public Health Std. (Finished Water)				
Metals				
01075	Dissolved Silver	0-10000 ug/1	50 ug/1	PHS
01145	Dissolved Selenium	" "	10 ug/1	"
Other				
00720	Cyanide	0-10 mg/1	0.05 mg/1	"
00722	Free Cyanide	" "	" "	"
03503	Dissolved Beta Radiation	0-100000 pC/1	1000 pC/1 (if Sr 90 and alpha emitters absent)	"
09503	Dissolved Radium-226	0-1000 "	3 pC/1	PHS
09510	"	" "	"	"
13503	Dissolved Strontium 90	" "	10 pC/1	"
80050	Dissolved Beta Radiation	0-100000 "	1000 pC/1 (if Sr 90 and alpha emitters absent)	"
Salinity Related Conductivity				
00094	Conductivity	0-375000 μMHO	1500 μMHO	Nominal x 1.5
00095	"	" "	" "	" "

Table 1

PARA #	BRIEF DESCRIPTION	EDITING LIMITS	STANDARD VALUE	SOURCE
Salinity				
00515	Dissolved Solids	0-250000 mg/1	1000 mg/1	Nominal
70295	"	" "	"	"
70300	"	" "	"	"

Source Key:

STATE STD - Appropriate State Standard.
NOMINAL - General Literature Review.
CORVALLIS - Corvallis Eutrophication Laboratory (Modified "Sawyer" Numbers).
WQC - U. S. EPA's"Water Quality Criteria - 1972."
PHS - Public Health Service Drinking Water Standards - 1962.

V. Water Quality Index Approach

A. Methodology:

To assess trends a method was sought which could, if possible, identify by number basic changes in water quality. A simple, easily understood method was desired which at the same time was neither obtuse or simplistic. To this end Region VIII's 1975 Water Quality Index was developed.

Aided by fresh concepts and the need for a water quality assessment required of each Region by Section 305(b) of P.L. 92-500 an Index was developed building on experience earned in 1973. This Index used some of the conceptual ideas developed by the National Sanitation Foundation (NSF) for its "Water Quality Index Application in the Kansas River Basin" and those of EPA's Region X in its "Water Quality Index". Tempering these concepts with the experience and knowledge of the kinds and characteristics of data in Region VIII an Index emerged that was simple and had the advantage of being reasonably unrestricted by extensive data requirements and one that was free of statistical devices to supplement missing data.

For organizational purposes and to best utilize limited resources mainstem segments were the focus of the analysis. Important intrastate, interstate, and international watercourses were selected after preliminary screening indicated reasonable data coverage.

1. Weighting.

In line with Region X's approach equal weighting was sought.

To attain equal weights minor realignment of parameters was necessary for four of the groups used for the 1973 Index. A fifth group, the "Hazardous" group was considered unacceptable with even weights since 1973 data was either poorly distributed or unavailable. "Hazardous" considerations were switched to the "severe events" analysis discussed in Section VI. Weights developed by the NSF were used as a reference for the equal weight assignments.

Each group was given an equal weight of 0.25. Group 1, consisting of D.O. - NSF weights are shown in parentheses- (0.17) and BOD (0.11) had a combined NSF weight of 0.28 which was considered too high since few D.O. and BOD violations occur on Region VIII mainstems at least as measured by fixed sampling stations. Group 2 consisting of total (0.0) and fecal coliform (0.16) had a combined NSF weight of 0.16 and it too was considered too low because total coliform are more resistant to chlorination, and may indicate, at least in watercourses influenced by STP wastewater, the presence of more tolerant or longlived pathogens. Total coliform also may indicate non-point sources of pollution as well. Group 3 consisting of nitrogen (0.10) and phosphorous (0.10) was thought weighted too low by NSF at 0.20 since the National Water Quality Assessment of 1972 highlighted nutrient enrichment as the number one water quality problem. (Since both N&P must be available each were Index weighted at 0.125). Group 4, a collection of salinity and aesthetic related parameters (represented by NSF with total solids 0.07 and turbidity 0.08) was considered as weighted too low by the NSF at 0.15 since these parameters are related to irrigation return, and land use practices which are not readily resolvable and apparently are worsening year by year. pH (0.11) and temperature (0.10) weights were not used since these parameters are not significant problems in Region VIII.

2. Calculation:

After screening out bad data, the percentage of "violations" in each group was calculated for both trend periods, viz., 6907 - 7207 and 7107 - 7407. This percentage was raised to the even weighted 0.25 power and the product of the groups taken. Graphically, the calculation was as follows:

$$\left(\begin{array}{l}\%\text{ violations}\\ \text{DO \& BOD}\end{array}\right)^{.25} \times \left(\begin{array}{l}\%\text{ violations}\\ \text{Bac-T}\end{array}\right)^{.25} \times \left(\begin{array}{l}\%\text{ violations}\\ \text{Nitrogen}\end{array}\right)^{.125} \times$$

$$\left(\begin{array}{l}\%\text{ violations}\\ \text{Phosphorous}\end{array}\right)^{.125} \times \left(\begin{array}{l}\%\text{ violations}\\ \text{Physical/Aesthetic}\end{array}\right)^{.25} = \begin{array}{c}\text{Water Quality}\\ \text{Index}\end{array}$$

Since each group has a number from 0-100 and the sum of the fractural exponents used is 1, the WQI is also a number from 0 (best) to 100 (worst). (If a group had a violation percentage less than 1 or it had no violations the value of the group was made 1 so that the product of the group would not be zeroed out or go to less than 1.) Roughly, a Water Quality Index of 10 corresponds to violation of state standards 10 percent of the time in each group.

3. Constraints:

In essence each group must have a high percentage of violations for the Index to be high. This is empirically sound since a water-courses quality should not be considered bad simply because of Bac-T problems which limit contact recreation but does not at the same time limit fishing. Similarly, a watercourse that has D.O. problems but not Bac-T problems would not necessarily limit contact recreation.

If any group had no data, a rating was not assigned and the station listed as not rateable (NR). A minimum of 6 values per group (6 each for N&P) was considered the smallest sample size that could be accomodated for Index analysis. (In fact, rateable stations were generally trend type stations that had many more observations in each group and a large data base generally resulted at least for each segment.)

An index value was computed for each rateable station and for each state-use segment and also for some subsegments.

To assist in sorting out the large number on non-trend stations, a "data-rich" approach was taken (See Appendex 1). By this pre-selection process a reasonable breadth of data was required for a station to be included in the survey. If different agencies each collected small amounts of data for different parameters the station location would unfortunately not appear in the survey.

B. Shortcomings.

Given the advantages of the Index as a springboard for water quality assessment certain shortcomings should be highlighted. As stated throughout this report, shortage of data is a basic limitation of the Index and this overall review. For one, a toxic group was not included in the Index for lack of data. If data were available in sufficient quantity with reasonably good distribution it would be a simple matter to include this group in the Index but this data was simply not available. So, rather than seriously limit station coverage further from the present coverage of 87 stations rateable in both periods to 25 or less, it was decided to treat hazardous substances separately as "severe events".

Without toxic data the Index is slanted toward sewage treatment plant discharges, organic related effluents and irrigation return flow. Yet, since much effort has been placed in these areas this is not, at least at this time, viewed as a serious limitation. Treatment of pH and temperature were excluded from the Index, since in the first place great quantities of these easily measured parameters were collected and in the second violations were infrequent and consequently, inclusion would tend to skew or distort the Index values; especially the segment Index. Exclusion does, however, make the Index somewhat conservative.

Bad data or other sources of error, such as intensive data concentrated in one group; for example D.O. and conductivity below Missouri River dams, could conceivably skew the segment rating, but these potential limitations did not in reality act as a distorting influence on any station or segment rating. Other sources of potential misdirection in the Index could be the variability of certain state standards, such as coliform values, and the presence of a standard; for example, color, in one state and not another. These potential variables were identified and evaluated and overall only slight variations are believed to exist. Variability detected due to over-concentration of data in one season or seasons was cause for exclusion of that station or segment from being rated.

Meteorological variability was not accountable.

Possible error due to duplicate storage of like parameters was screened out during the raw data review. In cases where a value, such as salinity, was stored jointly as conductivity and total residue; only one of the values was used.

Most indexes do not consider flow as a variable, probably since violations of state standards apply at all but very low flows, and flow is not widely collected outside of the USGS network. (In fact, only 31 rateable stations had 20 or more mean flow observations in STORET together with water quality and for 11 of these the flow was deduced from nearby flow stations.) Flow weighting for trend analysis would be desirable but in the absence of sufficient data other methods were necessary. Effects of flow versus concentration and flow versus the Index was analyzed using regression analysis with results given in Section IX. Bearing in mind the limited number of stations involved, flow did not seem to be a significant variable.

Aggregating all these shortcomings and qualitative judgements, the Index is not seen either individually or collectively as limited, if used wisely. Overall the conclusions based on the Index are considered sound. Hair-splitting is not recommended when using the Index, for example a rating of 60 is not significantly different than 50 nor is a 2 much different than a 4.

VI. Severe Events Approach

A. Hazardous Substances:

During development of the Index it became apparent that the data, as available, in a proposed "Hazardous to Man and Fish" group was poorly or unevenly collected. This group would have included toxic "Blue Book" levels to fish, and also Public Health Drinking Water Standards. The limited data base was noted in Region VIII's 1973 Index but it was not as critical since only three of five groups required data for a rating whereas all groups must be rateable in the 1975 Index. Importantly, this kind of data often requires sophisticated equipment for analysis and generally is expensive to generate. These data also have high relative error and standard deviation percentages (Standard Methods, page 106 and 215) indicating a high potential for divergence in accuracy and precision. Source of the data is therefore important. USGS data was analyzed without reservation, but other sources which may have employed less sophisticated methods were given wider latitude for marginal violations.

Hazardous substance violations are alarming in and of themselves, but sources of heavy metals violations often are not readily pinpointed and/or corrected. Presistent violations are cause for concern but infrequent exceedance for one parameter was not observed with alarm.

Absence of violations does not indicate the absence of a problem but may suggest reexamination for possible monitoring to ensure that, in fact, no problem exists. Much more data is required in the "hazardous" area and efforts such as the National Pesticides Monitoring System, Drinking Water Review and the NWQSS and NASQAN programs are beginning to focus broad based attention and resources in this area.

B. Temperature and pH:

Temperature and pH change from ambient was not included in the Index but viewed as a severe event since violations are infrequent and also not generally assessable with STORET data.

C. Fish Kills:

Fish kills are obvious "severe events" but the causes generally are not so obvious, at least for the smaller kills. Fish kills were treated separately since quantification is nearly impossible for these events. Also, since the 1972 EPA sponsored "Fish Kills - Caused by Pollution in 1972" report little emphasis has been made on centralized data collection.

D. Salinity:

Salinity has been considered a severe event when general usefulness for drinking, irrigation and/or industrial use is impaired. A nominal value of 1,000 mg/l, as suggested by a literature survey, was used as a benchmark for these events.

E. Severe Event Overview:

In all, there are seven groups lumped under the severe events heading: Toxic Pesticides to Fish, Toxic Non-pesticides to Fish, Public

Health Drinking Water (1972) Standards, Temperature excesses of State Standards, pH outside 6 - 9, Fish Kills, and Salinity.

Efforts to quantify the evere events into a composite value by computing a ratio of events to observations did not yield meaningful data, since the data was not normally distributed.

1. Toxic Pesticides to Fish

Generally, "pesticide" data is unavailable at all but a few stations. A review of the available data at all Region VIII stations from 6907 - 7407 was performed and a complete list of stations where pesticides were monitored, highlighting those that showed no trace and those that showed noxious traces are given in Table 2 and Table 3. As can be seen numerous instances of "pesticides" values in excess of "Blue Book" values were found. (Significant quantities of 2,4-D were detected at many stations but in the absence of toxic criteria the presence of this herbicide in amounts greater than 0.1 mg/l are simply noted.) Possible additive or synergistic effects are not accounted for.

Blue Book excesses were often noted at the South Platte at Henderson, Colorado; the South Platte at Kersey, Colorado; the Arkansas below John Martin Reservoir, Colorado; the Red River of the North below Fargo, North Dakota; the Souris near Foxholm, North Dakota (Diazinon only); Rapid Creek near Farmingdale, South Dakota; and the Bighorn River near Kane.

Table 2

Region VIII

Pesticide Review -
No Trace

Station Number (All 112 WRD)	Name and Location and Latest Date Collected	Stations With No Pesticide Residues or 2,4-D Less Than 0.1µg/l
Colorado		
06710000	S. Platte/Littleton 72-04-24	One sample - 13 constituents
06748600	S. Fork Cache La Poudre 72-05-19	One sample - 17 constituents
06752000	Cache La Poudre/At Mouth 72-05-18	One sample - 16 constituents
Montana		
06191500	Yellowstone/Corwin Springs 72-02-24	Two to seven samples - 17 constituents
06214050	Clark Fork/Yellowstone River 72-04-17	Nine to fourty-two samples - 17 constituents
06218000	Yellowstone/Custer 70-01-28	Two to three samples - 12 constituents
06324500	Powder/Moorhead 72-04-04	Two to three samples - 12 constituents
06329500	Yellowstone/Sidney 73-10-18	One to two samples - 18 constituents

Pesticide Review Cont.

Station Number (All 112WRD)	Name and Location and Latest Date Collected	Stations With No Pesticide Residues or 2,4-D Less Than 0.1 μg/l
Montana		
12301500	Kootenai/Rexford 72-07-26	Two samples - 13 constituents
12301830	Lake Koocanusa/At Ten Mile Cr. 74-05-23	Two to ten samples - 27 constituents
North Dakota		
05051010	Red River below Wahpeton 70-06-04	One to three samples - 13 constituents
06338490	Missouri/Garrison Dam 72-04-04	One sample - 45 constituents
South Dakota		
06360500	Moreau/Whitehorse 70-05-19	Two to four samples - 12 constituents
06395000	Cheyenne/Edgemont 73-09-18	Two to seven samples - 17 constituents
06409000	Castle Creek/Near Hill 72-10-24	One to six samples - 18 constituents

Pesticide Review Cont.

Station Number (All 112 WRD)	Name and Location and Latest Date Collected	Stations With No Pesticide Residues or 2,4-D Less Than 0.1 μg/1
South Dakota		
06423500	Cheyenne/Wasta 70-04-16	Three samples - 13 constituents
06439500	Cheyenne/Eagle Butte 73-09-18	Four samples - 18 constituents
06447000	White/Kadoka 70-04-14	Three to four - 13 constituents
06452000	White/Oacoma 70-05-14	Two to four samples - 13 constituents
06481500	Skunk Creek/Near Sioux Falls 70-06-16	Three samples - 13 constituents
Utah		
09306500	White/Watson 73-04-27	Two samples - 18 constituents
09306900	White/Ouray at Mouth 74-10-04	One sample - 15 constituents

Pesticide Review Cont.

Station Number (All 112WRD)	Name and Location and Latest Date Collected	Stations With No Pesticide Residues or 2,4-D Less Than 0.1µg/1
Wyoming		
06660000	Laramie/Laramie 70-04-23	Four samples - 12 constituents
06674500	N. Platte/Wyo-Neb. Border 72-01-10	Three to seven samples - 17 constituents

Table 3
Region VIII

Pesticide Review - Excesses

Colorado

Station Number (All 112WRD)	Name and Location and Latest Date Collected	Pesticide Residue At or Above Blue Book Excesses & 2,4-D >0.1 μg/l (Excesses/No. Obs.)
06720500	S. Platte/Henderson 72-05-04	Chlordane 2/8, DDD 3/11, DDT 4/11, Dieldrin 8/10, Malathion 1/4, Diazinon 1/4, 2,4-D 5/10
0673100	St. Vrain/At Mouth 72-05-04	Diazinon 1/1, 2,4-D 1/1
06744000	Big Thompson/At Mouth 72-05-11	Diazinon 1/1
06752500	Cache La Poudre/At Mouth 72-05-23	Dieldrin 1/1, Diazinon 1/1
06754000	S. Platte/Kersey 73-09-11	DDE 3/7, Dieldrin 4/8, Endrin 1/8, 2,4-D 2/7, Diazinon 7/7
06764000	S. Platte/Julesburg 74-04-17	DDE 1/2, DDT 1/2, Dieldrin 1/2, Diazinon 1/2
06764200	S. Platte/Julesburg 73-04-27	DDE 1/3, Dieldrin 1/3
07130500	Arkansas/Below John Martin Res. 71-09-09	DDD 1/22, DDT 3/22, Dieldrin 3/22

Pesticide Review Cont.

Station Number (All 112WRD)	Name and Location and Latest Date Collected	Pesticide Residue At or Above Blue Book Excesses & 2,4-D >0.1 µg/l (Excesses/No. Obs.)
Montana		
06174200	Milk/Near Glascow 72-04-18	2,4-D 3/8
06214500	Yellowstone/Billings 72-04-18	2,4-D 1/22
06287000	Bighorn/St. Xavier 70-04-20	DDT 1/4
05060600	Sheyenne/Harwood 72-06-28	2,4-D 1/11
05064900	Beaver Creek/Finley 73-05-01	DDT 1/4, Diazinon 1/3
05082500	Red River of North/Grand Forks 73-09-26	DDE 1/7, Diazinon 2/5
05083500	Red River of North/Oslo 74-05-01	DDE 1/1, DDT 1/1
05102490	Red River of North/Pembina 72-06-27	2,4-D 2/10
05116000	Souris/Foxholm 74-04-18	Diazinon 3/3

Pesticide Review Cont.

Station Number (All 112WRD)	Name and Location and Latest Date Collected	Pesticide Residue At or Above Blue Book Excesses & 2,4-D >0.1 μg/1 (Excesses/No. Obs.)
Montana		
05120000	Souris/Verendrye 72-06-28	2,4-D 1/12
06470830	James/Oakes 72-03-29	Dieldrin 1/10, Diazinon 1/2, 2,4-D 2/10
South Dakota		
06421500	Rapid Creek/Farmingdale 70-05-21	DDD 1/2, DDT 1/2, Dieldrin 1/2, 2,4-D 1/2
06438000	Belle Fouche/Elm Springs 72-04-11	2,4-D 2/10
06471000	James/Columbia 70-06-10	DDT 1/4
0647600I	James/Huron 70-09-17	2,4-D 6/11
06476000	James/Huron 71-09-30	2,4-D 7/19
06478500	James/Scotland 72-01-30	2,4-D 5/10

Pesticide Review Cont.

Station Number (All 112WRD)	Name and Location and Latest Date Collected	Pesticide Residue At or Above Blue Book Excesses & 2,4-D >0.1 μg/l (Excesses/No. Obs.)
South Dakota		
06479000	Vermillion/Wakonda 70-06-30	Dieldrin 2/4, 2,4-D (Max. 2,4-D - 7.0 μg/l)
06480000	Big Sioux/Brookings 70-06-16	2,4-D 1/4
06482100	Big Sioux/Brandon 70-05-25	Dieldrin 1/4, 2,4-D 2/3
Utah		
09315000	Green/Green River 71-09-08	DDT 1/24
10224000	Sevier/Lynndahl 74-05-08	Diazinon 1/5
Wyoming		
06259500	Bighorn/Thermopolis 70-05-27	2,4-D 3/4
06279500	Bighorn/Kane 73-08-01	DDE 1/8, DDT 1/8, Dieldrin 1/8, Diazinon 3/4, 2,4-D 2/8

Notes: Short term data from 72-09-18 / 72-11-15 collected by the State of Utah in 1972 has noted traces of several pesticides at: * = watercourse

A. St. George STP Effluent (Dieldrin)

*B. Virgin River above St. George (DDE, DDT)

*C. Kanab Creek Above Kanab (DDE, DDT, DDD, Heptachlor)

D. Kanab STP Effluent (DDD, DDE, DDT, Dieldrin, Heptachlor)

*E. North Fork Virgin River above Zion (DDD, DDE, DDT, Heptachlor)

F. Cedar City STP Effluent (Dieldrin)

G. Zion National Park STP Effluent (DDD, DDE, DDT, Dieldrin Heptachlor)

H. Monticello STP Effluent (Dieldrin)

I. Green River STP Effluent (DDT, Dieldrin)

*J. Green River above Green River (DDE, DDT)

K. Bonanza STP Effluent (DDE, DDT, Dieldrin)

L. Manilla Lagoon Effluent (DDE, DDT, DDD, Dieldrin)

M. Roosevelt Lagoon Effluent (DDD, DDE, DDT, Dieldrin)

N. Vernal STP Effluent (DDD, DDE, DDT, Dieldrin)

O. Dutch John STP Effluent (DDE, DDT)

P. Huntington Effluent (Dieldrin)

*Q. Colorado River Above Moab (DDE, DDT, Dieldrin, Heptachlor)

R. Atlas Minerals-Moab Effluent (DDE, DDT, Dieldrin, Heptachlor)

S. Orem STP Effluent (DDD, DDE, DDT, Dieldrin, Heptachlor, Diazinon)

*T. Lindon Hollow above Grove STP (DDD, DDE, DDT, Dieldrin, Heptachlor)

U. American Fork STP Effluent (DDD, DDE, DDT, Dieldrin, Heptechlor, Diazinon)

*V. West Mill Pond above Lehi STP (DDD, DDE, DDT, Hepitachlor)

*W. East Mill Pond above Lehi STP (DDD, DDE, DDT, Heptachlor)

X. Lehi STP Effluent (DDD, DDE, DDT)

Y. U.S. Steel Effluent Geneva (DDD, DDE, DDT, Dieldrin, Heptachlor)

*Z. Spring Creek above Heber City (DDD, DDT)

A-1 Heber City STP Effluent (DDD, DDE, DDT, Dieldrin)

B-1 Widway STP Effluent (DDD, DDE, DDT, Dieldrin, Heptachlor)

*C-1 Salt Creek above Nehi (DDE, DDT.

D-1 Delta STP Effluent (DDE, DDT)

E-1 Richfield STP Effluent (DDD, DDE, DDT, Dieldrin)

*F-1 Vermillion Canal at Diversion (DDE, DDT, Heptachlor)

*G-1 Sevier River above Salina River (DDT, Heptachlor)

H-1 Magna STP Effluent (DDD, DDE, DDT, Dieldrin, Heptachlor)

*I-1 Kersey Creek below Magna STP (DDD, DDE, DDT, Dieldrin, Heptachlor)

J-1 Tooele STP Effluent (DDD, DDE, DDT, Dieldrin, Heptachlor)

K-1 Hercules STP Effluent (DDD, DDE, DDT, Dieldrin, Heptachlor)

*L-1 C-7 Ditch near Saltair (DDD, DDE, DDT, Heptachlor)

Little pesticide data is available in 1973 or 1974. 1974 data is only available at Julesburg, Colorado on the Platte; the Red River of the North at Oslo, North Dakota; the Souris River near Foxholm, North Dakota; Lake Koocanusa at Ten Mile Creek, Montana; and the Sevier River near Lynndyl, Utah.

Presumably, problems associated with DDT and related products such as DDE and DDD should be cleared up by a severe ban on its use. Uses of Dieldren have been curtailed and noxious traces of this compound should also diminish in the near term. Diazinon, and 2,4-D, remain as the prime areas of continuing concern.

2. Toxic Non-pesticides to Fish:

Toxic constituents in water that could impair uses and/or creation of a balanced fishing must be considered within a complex matrix of chemical and biological interrelations. System dynamics are most important prior to judging if a watercourse is really unacceptable. Cadmium, for example, is more toxic in soft water. Given proper conditions, trout and other aquatic lift can acclimate to the presence of zinc and other potentially toxic constituents. Temperature and pH are directly related to the presence and quantity of unionized ammonia (toxic constituent of total ammonia).

Toxic conditions, based on Blue Book levels, abound in Region VIII and in the interest of data reduction, only stations with three or more events were highlighted. The incidence of events does not correlate well with fish kills, so seemingly the problem is one of indirect effect on fish.

High background metals due in large measure to past and present mining activities are known in Colorado and Montana and data collected for heavy metals, especially for zinc, indicates a high incidence of toxic conditions related to these activities. The U.S. Corps of Engineers has found unexplained quantities of mercury along the Missouri River system in Montana, and North and South Dakota. High mercury levels were noted on the Cheyenne River in South Dakota. High levels of nearly all heavy metals tested along the Red River of the North suggest additional scrutiny is needed to fully assess these conditions. Scattered but marginal cadmium excesses were detected at several locations, most noteably on the Red River of the North and the Jordan River.

Synergistic effects are difficult to assess on any trend basis but a number of stations had high values for several heavy metals. Stations noting three or more violations for each of three heavy metals were the Rio Grande River near Lobatos, Colorado; the Clark Fork River at Galen, Deer Lodge and near Missoula, Montana; and the entire length of the Red River of the North. A summary of metals violations on a metal-by-metal basis is given below:

1. Copper.

Copper is found on the South Platte at the Denver Water Board Intake, and at Marston Lake; on the Missouri River at Toston, Montana; on the Clark Fork at Deer Lodge, Montana; on the RRN at Fargo, between Fargo and Grand Forks, as well as at the Canadian border.

2. Lead.

Lead was only detected on the Red River of the North below Fargo, at Oslo and near the Canadian border.

3. Zinc.

Zinc was observed in Colorado at nearly all locations along the South Platte River, the Colorado River, the Arkansas River, and the Rio Grand River with especially high values at headwater stations. It was found in Montana on the Missouri River at Fort Benton and Toston, at Huntley on the Yellowstone, and especially on the upper Clark Fork and to a lesser extent on the lower Clark Fork. In North Dakota, zinc was found along the full length of the Red River of the North. It was observed on the Cheyenne and upper Big Sioux in South Dakota and at scattered locations on the Jordan River and at Cisco, Utah (suspect data) on the Colorado River. Zinc was also detected below Casper on the North Platte in Wyoming.

4. Mercury.

Mercury was seen at or near the border stations of the State of Colorado on the South Platte River, the Colorado River, and the Arkansas and Rio Grande Rivers. It was also observed along the full length of the Clark Fork and the Red River of the North. Mercury was detected in unusually high quantities at Newtown, North Dakota on the Oahe Reservoir and also found at Oahe Dam on the South Dakota reach of the Reservoir and in Lake Sharp at Big Bend Dam. Mercury was monitored at Verendrye, North Dakota, on the Souris River; at Edgemont, South Dakota, and near Eagle Butte, South Dakota, on the Cheyenne River.

Beyond the "standard" heavy metal analyses summarized in Table 4 little data is available to assess trends. Available data does show unionized ammonia to be a definate problem but one whose magnitude is not well defined. Data collection was not well distributed and much data was not useable since pH and/or temperature, both needed to assess the unionized fraction of a total ammonia analysis, were not available. Fish kill data does not correlate well with the presence of unionized ammonia. Frequent and often high unionized ammonia was found at Henderson, Colorado, on the South Platte River, and on the Big Sioux River below Sioux Falls. Troublesome quantities were monitored at Loma, Colorado, on the Colorado River, and on the Souris River near Westhope, North Dakota.

3. Public Health Drinking Water Review

a. Standards

Public Health Drinking Water Standards were heretofor, only required for interstate carriers. Recent legislation for "finished water" was promulgated standards for all states which will become effective December 16, 1976.

Typical drinking water treatment involves settling, and chlorination and/or in some cases cold-lime softening, pH adjustment and filtration. Usually, suspended material is nearly all removed. Cold-lime

Table 4

Heavy Metals Blue Book Excesses (3 or more) for Copper, Lead, Zinc & Mercury

Watercourse	Location	Violations/Obs.	Range
S. Platte	At Denver Water Board Intake	Copper - Tot. 4/28	21 → 750
	At South Platte	Zinc - Tot. 4/17	80 → 720
	Marston Lake	Copper - Tot. 18/25 Zinc - Tot. 4/15	20 → 105 42 → 225
	Above Littleton	Zinc - Tot. 3/24	70 → 760
	Henderson	Zinc - Tot. 10/25	
	Kersey	Zinc - Tot. 4/22	60 → 280
	Julesburg "	Copper - Tot. 3/5 Zinc - Tot. 6/28 Mercury - Tot. 5/7 Zinc - Tot. 5/5 Mercury - Tot. 3/6	20 → 120 60 → 580 0.2 → 0.8 40 → 100 0.2 → 0.6
Colorado	Dotsero	Zinc - Tot. 9/31	60 → 390
	Newcastle	Zinc - Tot. 7/35	70 → 280
	Cameo	Zinc - Tot. 6/27	100 → 850
	Fruita	Zinc - Tot. 5/26 Mercury - Tot. 4/8	80 → 400 0.4 → 0.9
	Loma	Zinc - Tot. 7/30	60 → 2200
Arkansas	Leadville	Zinc - Tot. 18/21	130 → 840
	Salida	Zinc - Tot. 10/33	60 → 140
	Pueblo	Zinc - Tot. 6/21 Mercury - Tot. 3/8	100 → 340 0.4 → 0.6
	Lamar	Zinc - Tot. 3/23 Mercury - Tot. 3/9	100 → 600 0.3 → 0.4
	Coolidge, Ks.	Zinc - Tot. 5/26 Mercury - Tot. 3/6	100 → 280 0.2 → 1.2
Rio Grande	Above Willow Creek	Zinc - Diss. 9/15	30 → 600
	Near Wasson	Zinc - Diss. 17/17	40 → 5800
	Manassa	Zinc - Tot. 3/22 Mercury - Tot. 3/7	80 → 640 0.2 → 10

Table 4

(Continued)

Watercourse	Location	Violations/Obs.	Ranges
Rio Grande	Lobatos	Copper - Diss. 4/91	20 → 66
		Zinc - Diss. 9/93	30 → 680
		Mercury - 8/64	0.6 → 2000
Montana			
Missouri: High individual violations at Zortman and Culbertsen, Montana were observed.			
Missouri	Toston	Copper - Tot. 4/4	50 → 140
		Zinc - Tot. 4/4	50 → 70
	Ft. Benton	Zinc - Diss. 4/7	30 → 40
Yellowstone: A high individual value was noted at Corwin Springs.			
Yellowstone	Billings	Copper - Diss. 3/6	30 → 42
	Huntley	Copper - Tot. 3/4	30 → 50
		Zinc - Tot. 4/4	60 → 110
	Sidney	Copper - Tot. 2/2	30 → 58
Clark Fork	Galen	Copper - Diss. 3/4	20 → 30
		Zinc - Tot. 10/10	60 → 530
		Mercury - Diss. 7/10	0.2 → 0.5
	Deer Lodge	Copper - Diss. 13/24	21 → 58
		Zinc - Tot. 21/22	40 → 520
		Mercury - Diss. 5/11	0.2 → 0.8
	Missoula	Copper - Diss. 4/21	22 → 63
		Zinc - Diss. 4/24	40 → 42
		Mercury - Diss. 4/11	0.2 → 0.9
	Alberton	Copper - Diss. 5/23	20 → 64
		Zinc - Diss. 4/22	35 → 84
	Thompson Falls	Zinc - Diss. 3/36	30 → 50
		Mercury - Diss. 12/21	0.2 → 1.0
Powder	Moorhead	Copper - Diss. 3/11	20 → 30
		Mercury - Diss. 3/9	0.4 → 0.9
Flathead Lake	Polson: A high individual violation was noted.		
North Dakota			
Missouri	Newtown	Mercury - Tot. 9/15	1.0 → 91 (?)
Souris	Foxholm	Copper - Tot. 3/9	20 → 30
	Westhope	Copper - Diss. 3/13	26 → 52

Table 4

(Continued)

Watercourse	Location	Violations/Obs.	Ranges
Souris	Verendrye	Copper - Diss. 4/16	26 → 60
		Mercury - Diss. 5/13	0.2 → 0.7
Red River of the North	Breckenridge	Copper - Diss. 5/48	20 → 48
		Zinc - Diss. 13/52	30 → 220
		Mercury - Diss. 15/41	0.2 → 4.1
	Below Wahpeton	Mercury - Diss. 6/8	0.2 → 1.2
	Fargo	Copper - Diss. 4/10	24 → 32
		Zinc - Diss. 7/30	31 → 180
		Mercury - Diss. 13/34	0.2 → 1.5
	Below Fargo	Copper - Diss. 3/19	20 → 112
		Lead - Diss. 7/48	36 → 220
		Zinc - Diss. 7/18	30 → 194
	Between Fargo & Grand Forks	Copper - Diss. 9/51	24 → 100
		Zinc - Diss. 27/53	30 → 490
		Mercury - Diss. 19/48	0.2 → 2.5
	Grand Forks	Copper - Diss. 5/51	20 → 24
		Zinc - Diss. 14/53	31 → 260
		Mercury - Diss. 23/42	0.2 → 2.5
	"	Mercury - Diss. 5/8	0.3 → 1.4
	Oslo	Copper - Tot. 3/7	20 → 60
		Lead - Diss. 3/52	40 → 300
		Zinc - Diss. 18/56	30 → 1000
		Mercury - Diss. 22/41	0.2 → 1.5
	Pembina	Copper - Diss. 5/12	20 → 48
		Zinc - Diss. 3/11	40 → 140
		Mercury - Tot. 3/7	0.4 → 2.4
	Near Pembina	Mercury - Diss. 5/8	0.2 → 2.0
	Near Border	Copper - Diss. 10/54	20 → 130
		Lead - Diss. 8/51	35 → 90
		Zinc - Diss. 26/53	30 → 280
		Mercury - Diss. 23/42	0.2 → 2.7
South Dakota			
Cheyenne	Edgemont	Copper - Diss. 4/8	29 → 75
		Zinc - Diss. 4/7	30 → 490
	Eagle Butte	Zinc - Tot. 5/5	30 → 750
		Mercury - Tot. 4/9	0.2 → 1.0
	"	Mercury - Tot. 4/10	3.2 → 11.0

Table 4

(Continued)

Watercourse	Location	Violations/Obs.	Ranges
Big Sioux	Dell Rapids	Zinc - Tot. 6/8	30 → 80
	Sioux Falls	Zinc - Tot. 8/9	30 → 180
James	Scotland	Mercury - Tot. 4/5	0.2 → 0.2
Oahe Reservoir	Mobridge	Mercury - Tot. 9/25	1.0 → 4.0
	Powderhouse	Mercury - Tot. 4/10	1.3 → 15
Lake Sharp	Below Big Bend	Mercury - Tot. 3/6	3.3 → 5.0

Utah

Jordan: Numerous lead and zinc violations were found along this watercourse but incidence of monitoring was to infrequent for trend assessment.

Jordan	12600 S.	Zinc - Diss. 4/7	40 → 188
		Mercury - Tot. 3/6	0.5 → 3.0
	"	Zinc - Diss. 3/12	50 → 138
Weber	Above Central Weber STP	Copper - Diss. 4/18	20 → 30
Green River	Above Green River, Utah	Copper - Diss. 4/32	20 → 40
Colorado	Cisco	Copper - Tot. 3/3	40 → 270
		Lead - Tot. 4/5	300 → 1800
		Zinc - Diss. 3/3	40 → 160
		Mercury - Tot. 3/3	0.2 → 0.4

Utah Lake: Numerous zinc violations occurred but incidence of recent monitoring was to infrequent to assess trends.

Wyoming			
N. Platte	Below Casper	Zinc - Diss. 3/3	60 → 90

softening removes some dissolved materials mostly in the form of carbonates or insoluble hydroxides. Dissolved selenium, lead, barium, radium and mercury, elements found in Region VIII watercourses, generally are not removed in significant quantities during normal treatment. A survey of in-stream waters focusing on these dissolved constituents should therefore approximate finished quality of this water.

During the trend period, selenium and cadmium were noted at many locations, but if found above the PHS limit were usually at/or near the 10 µg/l standard. Lead was detected along the Jordan River and on the South Platte at Julesburg, Colorado. Radium 226 was found on the Arkansas River near Kansas. Barium was detected on the RRN at Grand Forks and Drayton.

Limits of accuracy of approximately 20% for heavy metal tests must be considered in violations analysis. Frequency of violation is another important constraint, as are other violations of the same parameter on the same watercourse. All things considered selenium is a "stick-out" violation on the Clark Fork River and in Flathead Lake; a major source of water to the Clark Fork River. Mercury, a proposed standard, was found at or near the 2.0 µg/l rejection level at Pembina and Fargo on the Red River of the North.

Significantly this review indicates a serious lack of dissolved metals data on a broadly distributed basis.

"Finished" water quality data, if available, for the violations cited in Table 5 should be carefully cross-checked against these assumptions.

Table 5

Region VIII

Public Health Standards Violations Summary*
July, 1969 - June, 1974

Watercourse	Location	Violations/Obs.
South Platte	Julesburg, CO	Lead 2/4
Arkansas	Colo/Kansas Border	Radium-226 2/29
Missouri	Ft. Benton, MT	Selenium 1/7
Flathead Lake	Polson, MT	Selenium 2/16
Clark Fork	Deer Lodge, MT	Cadmium 1/17 Selenium 1/17
	Plains, MT	Selenium 1/12
	Thompson Falls, MT	Selenium 2/21
Powder	Moorhead, MT	Selenium 1/7
Red River of the North	Fargo, ND	Selenium 1/5
	Grand Forks, ND	Barium 1/2 Cadmium 1/31
	Drayton, ND	Barium 1/1
James	Lamoure, ND	Selenium 1/1
	Scotland, SD	Selenium 1/8
Souris	Westhope, ND	Selenium 1/6
Cheyenne	Edgemont, SD	Selenium 2/8
Jordan	Below Utah Lake, UT	Selenium 1/13
	Narrows	Cadmium 1/4 Selenium 1/4
	Bluffdale Road	Cadmium 3/10 Selenium 1/5
	12600 South	Lead 1/7
	Above Sandy	Cadmium 1/9
	Below Sandy	Lead 1/1

Table 5

Watercourse	Location	Violations/Obs.
Jordan	7200 South	Selenium 1/2
	Above Murray	Lead 1/6 Selenium 1/6 Cadmium 4/10
	Below Murray	Lead 1/3
	Below Jordan Meat	Lead 1/3 Cadmium 1/7
	2100 South	Cadmium 3/11 Lead 1/6
	Below 2100 South	Lead 1/2
	Cudahy Lane	Lead 1/17 Selenium 2/19 Cadmium 1/10
	Below S. Davis STP	Lead 1/1
Colorado	Above Moab, UT	Barium 1/7
Weber	Above Central Weber STP	Cadmium 1/6

Note: Dissolved mercury at the proposed standard of 0.002 mg/l was noted at Red River of the North, Pembina, N.D. 1/6.

* Data must be taken at face value since the absence of a violation may be due to lack of data.

b. Effects of Chlorination on Drinking Water

National assessment of the effect of chlorination has focused attention on five Region VIII water supplies, namely, Denver, Colorado; Pueblo, Colorado; Grand Forks, North Dakota; Huron, South Dakota; and Salt Lake City, Utah. Results of the single sample program showed Huron with extremely high chloroform, bromodichloro-methane and dibromochloromethane and total organic carbon (TOC); and Grand Forks with high TOC. Results are summarized in Table 6. Follow-up national sampling is planned for Grand Forks and contract work to assess the condition of Huron's apparent problem is underway.

Table 6

Effect of Chlorination

	Chloroform µg/l	Bromodichloromethane µg/l	Dibromo chloromethane µg/l	Bromo form µg/l	1,2-Dichloroethane µg/l	Carbon Tetrachloride µg/l	Non-Volatile Total Organic Carbon mg/l
Denver, Colorado	14	10	3	NF	NF	NF	1.7
Pueblo, Colorado	2	2	<2	NF	NF	NF	1.6
Grand Forks, North Dakota	3	1	NF	NF	NF	NF	5.2
Huron, South Dakota	309	116	49	8	NF	NF	12.2
Salt Lake City, Utah	20	14	8	NF	NF	NF	0.9

4. Temperature Excesses of State Standards

Protection of indigenous cold and warm water fish requires careful attention to the temperature of the watercourse. Protective state standards from 18.5°C. to 20°C. are used for cold water fisheries (with a 24.5°C. lethal standard in Wyoming) and generally 26.5°C. or 32°C. is used for warm water protection. (See State Standards Review in Appendix 4).

Few instances of instantaneous temperature excesses of greater than 2°C. above standare were observed anywhere in Region VIII. Persistent temperature excesses from 1° to 2°C. were noted along the Rio Grande below Alamosa, Colorado; at the South Platte River below the construction of Chatfield Dam; at Flathead Lake and on the Clark Fork River near Thompson Falls, Montana; on the Missouri River below the Garrison, Big Bend and Gavins Point Dams, on the Jordan, below Cudahy Lane and the South Fork of the Powder River near Kaycee. Wide departure from standards in excess of 2 °C. were observed on the Missouri below the Gavins Point Dam, and for single observations at the Green River near Jensen, and for the Weber River above the Central Weber STP near Ogden, Utah.

Generally temperature excesses are scattered single violations, and given the extremely numerous measurements are very few overall. Also, flow does not seem to be a factor since no violations were noted in the low flow watercourses. (<1000 cfs mean flow). There were no violations of warm water fishery standards as seen by attention to Table 7 below.

Table 7

Region VIII

Temperature Violations Summary*

Watercourse	Location	# Excesses/ # Obs.	Limit	Excess or Range of Excess °C
South Platte	Bailey	1/17	20°	2°
	Above Littleton	2/51	20°	0.5 - 2.2°
	Bowles Avenue	8/36	20°	0.5 - 3.3°
Arkansas	Canon City	1/81	20°	1°
Rio Grande	Alamosa	4/19	20°	0.5 - 1.5°
		2/40	20°	1.5 - 2°
	Lobatos	4/40	20°	4 - 4.7°
Missouri	Below Townsend	1/6	19.5°	1.5°
Clark Fork	Galen	1/41	19.5°	1°
	Thompson Falls	8/90	19.5°	0.1 - 2.5°
Big Horn	Hardin	1/38	19.5°	1.5°
	Bighorn	1/23	19.5°	1.5°
Flathead Lake		16/187	19.5°	0.2 - 2.5°
Missouri	Below Oake	539/3864	18.5°	0.05 - 4°
	Pierre	5/31	18.5°	1.5 - 2.1°
	Below Big Bend Dam	5/18	18.5°	1.0 - 5°
	Yankton below Gavins Point Dam	1/39	18.5°	8.5°
		5/3285	18.5°	8.5 - 11.5°
Jordan	Below Sandy	1/10	20°	1°
	Below Kearns STP	1/14	20°	1.0°
	Above Murray STP	1/6	20°	1.0°
	Cudahy Lane	2/9	20°	2.8 - 3.0°
	Below South Dover STP	2/14	20°	0.5 - 1.0°
Weber River	Above Central Davis STP	1/24	20°	8° (?)
Green River	Jensen	1/44	26.5°	11.5°
North Platte	Glenrock	1/22	25.5°	2.0°

Temperature Violations (Cont.)

Watercourse	Location	# Excesses/ # Obs.	Limit	Excess or Range of Excess °C
North Platte	Below Glendo	1/29	25.5°	1.5°
	Lingle	1/40	25.5°	1.0°
Wind Bighorn River	Worland	1/26	25.5°	0.5°
South Fork Powder	Kaycee	5/62	25.5°	0.1 - 2.5°
Powder	Arvada	1/40	25.5°	1.5°

* If no violations were detected in either period, 6907 - 7207 or 7107 - 7407 their number of observations are not added, hence, the ratio of violations to observations is, in most cases, conservative.

5. pH Outside 6 - 9

A divergent set of pH ranges are used in the State standards. For this review segment-by-segment ranges were first used as a benchmark, then the more broadly used range of 6.0 - 9.0 was also used as a benchmark. (Since STORET data does not have a code for pH departure from ambient, considerations such as "no change of 0.5 units is allowed from ambient" were not identifiable). Since it appeared at the outset that many of the marginal pH violations might be due to natural conditions and pH was not a significant violator, it was decided to only use the simple range of 6.0 - 9.0 for baseline analysis. Data analysis indicates few violations of 0.5 greater than 9.0 or 0.5 less 6.0.

Analyses does show that the Colorado River in Colorado and the Souris River in North Dakota as well as the full length of the James River did have some pH excesses. Wide divergence for single excesses were found at Leadville on the Arkansas River, the James River at Jamestown, the Souris River at Minot, North Dakota; at Edgemont on the Cheyenne River; and also on the Jordan River at the Draper-Riverton Road crossing in Utah. Causes for high pH's have not been determined on a case-by-case basis but mineral springs, and eutrophic conditions are suspect. Low pH's are generally associated with low D.O. or acid mine-drainage; compounded in some cases by flow. In terms of the large number of observations few pH violations were detected as can be seen by examining Table 8.

Table 8
Region VIII

pH Violations Summary
Outside 6 - 9

Watercourse	Location	# Excesses/ # Obs.	Excess or Range of Excess
South Platte	60th Avenue	1/491	+0.5
	88th Avenue	1/615	+0.1
	Balzac	1/8	+0.2
	Sterling	1/7	+0.3
	Julesburg	1/9	+0.5
Colorado	Hot Sulphur Springs	3/35	+0.1 ↔ +0.4
	Dotsero	3/28	+0.1 ↔ +0.6
	Glenwood Springs	1/53	+0.5
	Newcastle	2/28	+0.1 ↔ +0.5
	Cameo	1/51	+0.3
	Fruita	1/26	+0.6
	Loma	2/26	+0.1 ↔ +0.4
Arkansas	Leadville	2/28	-2.3 ↔ +0.1
	Canon City	1/15	+0.1
Rio Grande	Lobatos	1/53	+0.2
North Platte	Cowdrey	1/24	+0.3
Bighorn	Bighorn	1/23	+0.1
Red River of the North	Fargo	1/56	+0.2
	Emerson Canada	2/152	+0.1 ↔ +0.2
James	Jamestown	1/27	+0.9
	Oakes	2/107	+0.1 ↔ +0.4
Souris	Minot	1/43	+1.5
	Towner	1/30	+0.5
	Westhope	2/34 2/80	+0.3 ↔ +0.4 +0.3 ↔ +0.5
Cheyenne	Edgemont	1/34	-1.8
	Wasta	1/16	+0.5

pH Violations (Cont.)

Watercourse	Location	# Excesses/ # Obs.	Excess or Range of Excess
Big Sioux	Dell Rapids	1/53	+0.1
James	Hecla	1/14	+0.2
	Huron	2/22	+02. ↔ +0.4
	Scotland	2/70	+0.1 ↔ +0.7
Jordan	Draper-Riverton Road	1/24	-1.0
Colorado	Above Moab	1/26	+.05
Bear	Amalga	1/24	+0.25
Green	LaBarge	1/44	+0.1

6. Fish Kills.

Fish kill information is difficult to evaluate in terms of trends due to the general lack of data in the STORET fish kill file beyond 1972. For this review data beyond 1972 has been culled out of newspaper clippings, telephone reports, etc., and is listed chronologically as given in Table 9. Coordination of this data was attempted with each state.

Colorado fish kills apparently dropped in 1973 but have begun to increase in 1974. In North Dakota there have been few fish kills reported since 1972 with only two detected in 1973 and one in 1974. Likewise, South Dakota apparently had few kills with none reported in 1972 and one each in 1973 and 1974. Verified data in Colorado, Montana, Utah and Wyoming, indicate more kills but perhaps closer attention to smaller fish kills explains this anomaly.

Fish kills in Colorado and Montana occur predominantly from May thru October, with some mid-winter kills in Montana also noted. Fish kills in North Dakota occur mostly in spring with some noted in late summer, early fall and mid-winter. Kills in South Dakota are predominant from April thru August. Utah's fish kills generally occur in late winter and to some extent in July. Wyoming, which has had few reported kills since 1970, had several summer kills in 1969.

Overall, fish kills appear on the decline but this assessment is thought not to be definitive due to the lack of rigorous centralized reporting since 1972.

Table 9

Fish Kills 1968 - 1974

Watercourse	Location	Date	Fish Killed (Approx.)
COLORADO			
Rio Grande - Ponds	Creede	5-16-68	75
Timnath Lake - Ditch	Timnath	10-05-68	250,000
Chief Creek	Wray	7-21-69	NA
Mt. Shavano Hatchery	Nathrop	9-22-70	11,000
Cedaredge Hatchery	Delta County	8-05-71	40,000
Rio Grande River	Creede	8-31-71 9-01-71	600 40,000
Chicago Creek	Idaho Springs	5-12-72	20
Little Thompson River	Johnstown	6-26-72	200
South Platte River	Denver	6-27-72	10,000
Purgatory River	Las Animas	7- -72	6,000
Aqueduct Ditch	Fort Collins	7-10-72	200
St. Vrain River	Larimer County	8-28-72	112,000
Cache La Poudre	Greeley	6-26-72	NA
South Platte River	Denver	6-27-72	NA
St. Vrain - South Platte	Larimer County	9-04-72	NA
Little Thompson River	Greeley	9-10-72	NA
Irrigation Ditch	Boulder	10- -72	NA
Barr Lake	Larimer County	2-11-73	NA
Surface Creek	Delta	4-21-73	NA
Eagle River	Gilman	5-29-73	NA
South Platte River	Brush	5-16-74	NA
Fraser River	Fraser	6-05-74	NA
Pastorias Lake	Durango	7-18-74	NA

Table 9
(Cont.)

Watercourse	Location	Date	Fish Killed (Approx.)
Chalk Creek	Nathrop	7-23-74	NA
O'Leary Creek	Denver	8-01-74	NA
South Platte River	Denver	9-17-74	NA
Clear Creek	Wheatridge	12-18-74	NA
MONTANA			
Warm Springs	Anaconda	7-15-68	700
Warm Springs Creek	Anaconda	10-24-68	NA
Sixteen Mile Creek	Ringling	5-24-69	2,000
Prickly Pear Creek	East Helena	6-11-69	NA
So. Fork Musselshell	Martinsdale	8-07-69	NA
Whitefish River	Kalispell	11-07-69	NA
Rattlesnake Creek	Missoula	11-07-69	50
Sixteen Mile Creek	Mavldo	12-24-69	NA
Conley Pond	Hardin	4- -70	2,000
So. Fork Crow Creek	Ronan	2-04-71	5,300
Sixteen Mile Creek	Ringling	6-18-71	NA
Clark Fork River	Missoula	3-22-71	NA
Prickly Pear Creek	East Helena	8-27-71	3,000
W. Gallatin River	Gallatin Gateway	9-02-71	NA
Highwood Creek	Highwood	9-03-71	1,000
Denmy Creek	W. Yellowstone	9-29-71	NA
Donavan Creek	Clinton	1-10-72	NA
Prickly Pear Creek	East Helena	7-12-72	NA
Fairground Creek	Helena	9-28-72	50
Kootenai River	Libby	4-06-72	NA
Jacks River	Covalli	7-03-73	NA
Blacktail Deer Creek	Dillon	7-11-73	NA
Blacktail Creek	Butte	7-14-73	NA

Table 9
(Cont.)

Watercourse	Location	Date	Fish Killed (Approx.)
Prickly Pear Creek	Helena	1-14-74	NA
Warm Springs Creek	Clancy	7-13-74	NA
Teton River	Choteau	8-13-74	NA
Danielson Reservoir	Scobey	8-09-74	NA
North Dakota			
Souris River	Towner	4-12-68	500
Heart River	Dickinson	1-02-70 9-08-70	25,000 25,000
Red River	Fargo	9-30-70	12,000
Plum Creek	Lefor	5-15-72	NA
Northgate Dam	Northgate	6-30-72	25,500
Heinrich Lake	Ashley	7-25-72	22,000
Powers Lake	Powers Lake	8-20-72	4,500
Crown Butte Dam	Mandan	8-30-72	13,500
Souris River	Minot	1-26-73	NA
Red River	Fargo	4-17-73 4-11-74	NA NA
SOUTH DAKOTA			
Rapid Creek	Rapid City	6-22-68	NA
Big Sioux River	Sioux City	7-07-68	100,000
Battle Creek	Keystone	7-30-68	5,000
Grace Coolidge Creek	Custer	11-23-69	5,000
Menno Lake	Menno	8-22-70	7,000
Roderick Dam	Artesian	5-01-71	5,000
Spit Rock Creek	Corson	6-05-71	300
Rapid Creek	Rapid City	8-10-71	5,000
James River	Huron Mitchell	6-29-73 4-11-74	NA NA

Table 9
(Cont.)

Watercourse	Location	Date	Fish Killed (Approx.)
UTAH			
Utah Lake	Provo	1-11-68 2-28-68	60 55
Price River	Castlegate	3-01-68	150
Smithfield Creek	Smithfield	7-17-68	300
Utah Lake	Orem	9-01-68	11,000
Otter Creek	Koosharem	7-02-69	1,200
Ogden River	Ogden	2-09-70	300
Irrigation Ditch	Provo	7-28-71	110
Gunlock Reservoir	Gunlock	2-11-74	NA
Spring Creek	Springdale	2-17-73	NA
Green River	Green River	7-19-74	NA
Logan River	Logan	9-04-74	NA
WYOMING			
Encampment River	Riverside	7-27-68	250
Poison Springs Creek	Casper	3-06-69	NA
North Platte River	Casper	6- -69	NA
Gowan Reservoir	Casper	6-02-69	100
Wagonhound Creek	Douglas	6-16-69	2,000
North Platte River	Casper	7-22-69	NA
Mid Popo Agie River	Lander	8-04-69	200
Powell Gravel Pond	Powell	1-23-70	50
N. Crow Reservoir	Cheyenne	3-13-70	1,000
Fk. Popo Agie River	Lander	7-20-70	200
Big Horn River	Worland	8-08-70	8,000
Shoshone River	Cody	11-16-71	12,000
Popo Agie River	Lander	4-12-72	NA
Teton River	Teton	8-19-74	NA
La Preele Creek	Douglas	9-07-74	NA

NA = Not Available

7. Salinity.

Trends are especially difficult to assess in the short run since natural cycles tend to mask "salt load" analysis. Salt load was examined in the trend period at 13 data rich stations with ample data for a resonable review. A graphic STORET display of these analyses is given in Figures 1A thru 1M. No clear trends have emerged although the Missouri River at Culvertson, Montana, has shown a steady decline in salt load from 1969 - 1974. Correlation analyses of flow versus concentration yielded universally high coefficients along all watercourses, generally in the .95 or higher range. These high coefficients suggest a near linear relationship for flow and concentration; thus little apparent change has occurred during this five year trend period. Again the lack of flow-tied water quality data has limited trend assessment.

Severe event data serves to characterize the station locations where salinity is a deterent to full usefulness. These events note observations at or greater than 1,000 mg/l of dissolved solids (or the equivalent conductivity of 1,500 μMHO) on the following watercourses:

1. S. Platte River. Salinity events begin at Kersey and intensify to the Nebraska border,
2. Colorado River. (Colorado and Utah segments). Occasional events beginning at Fruita and continuing to Lake Powell were observed,
3. Arkansas River. Severe events originate at La Junta intensifying to very severe levels at the Kansas border,
4. Powder River. (Wyoming and Montana segments). Numerous events were noted at Arvada, Wyoming; modifying to a small extent as the river flowed north to Moorhead, Montana,

5. James River. (North Dakota and South Dakota segments). Frequent events noted along the entire watercourse from Jamestown, North Dakota to Mitchell, South Dakota, intensifying somewhat at Scotland, South Dakota; near the confluence with the Missouri River,

6. Souris River. Frequent events from Minot to the Canadian border, intensifying below Verendrye, North Dakota, to Westhope, North Dakota, where concentrations are noteably higher from 1972 to 1974,

7. Cheyenne River. Extremely intense and frequent events were observed at Edgemont, South Dakota; which became modified, but still frequent along the river to its confluence with the Missouri River,

8. Big Sioux River. Occasional events were observed below Sioux Falls to its confluence with the Missouri River,

9. Jordan River. Occasional events were noted in the upper reach becoming frequent in the middle reach and remaining frequent but less intense in the lower reach, and

10. Weber River. Occasional events were observed at the Gateway, Utah, at its headwaters station.

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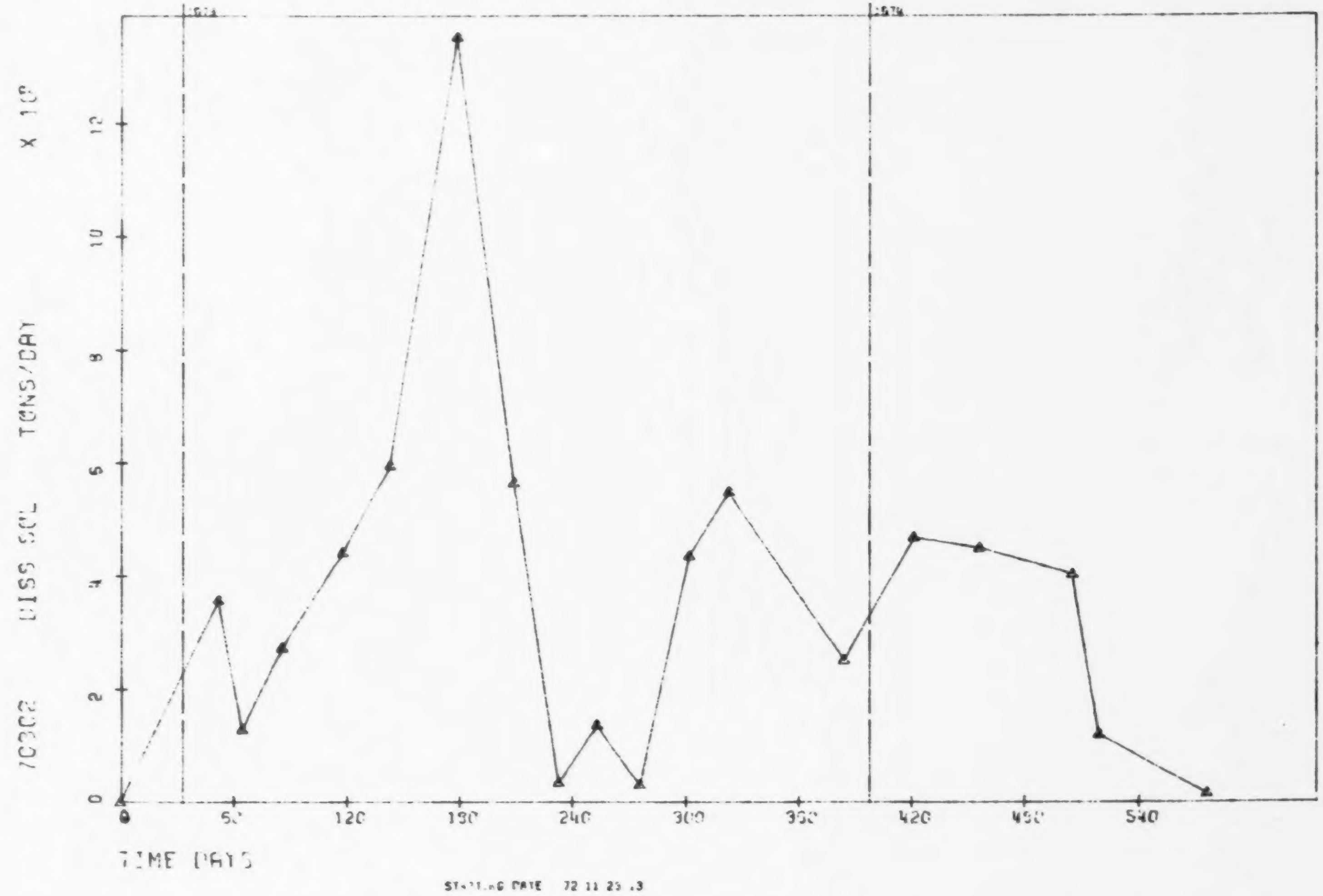
06764000
40 58 40.0 102 15 15.0
SOUTH PLATTE RIVER AT JULESBURG.
03

Figure 1A

112WRD
2

77777777
0000 FEET DEPTH



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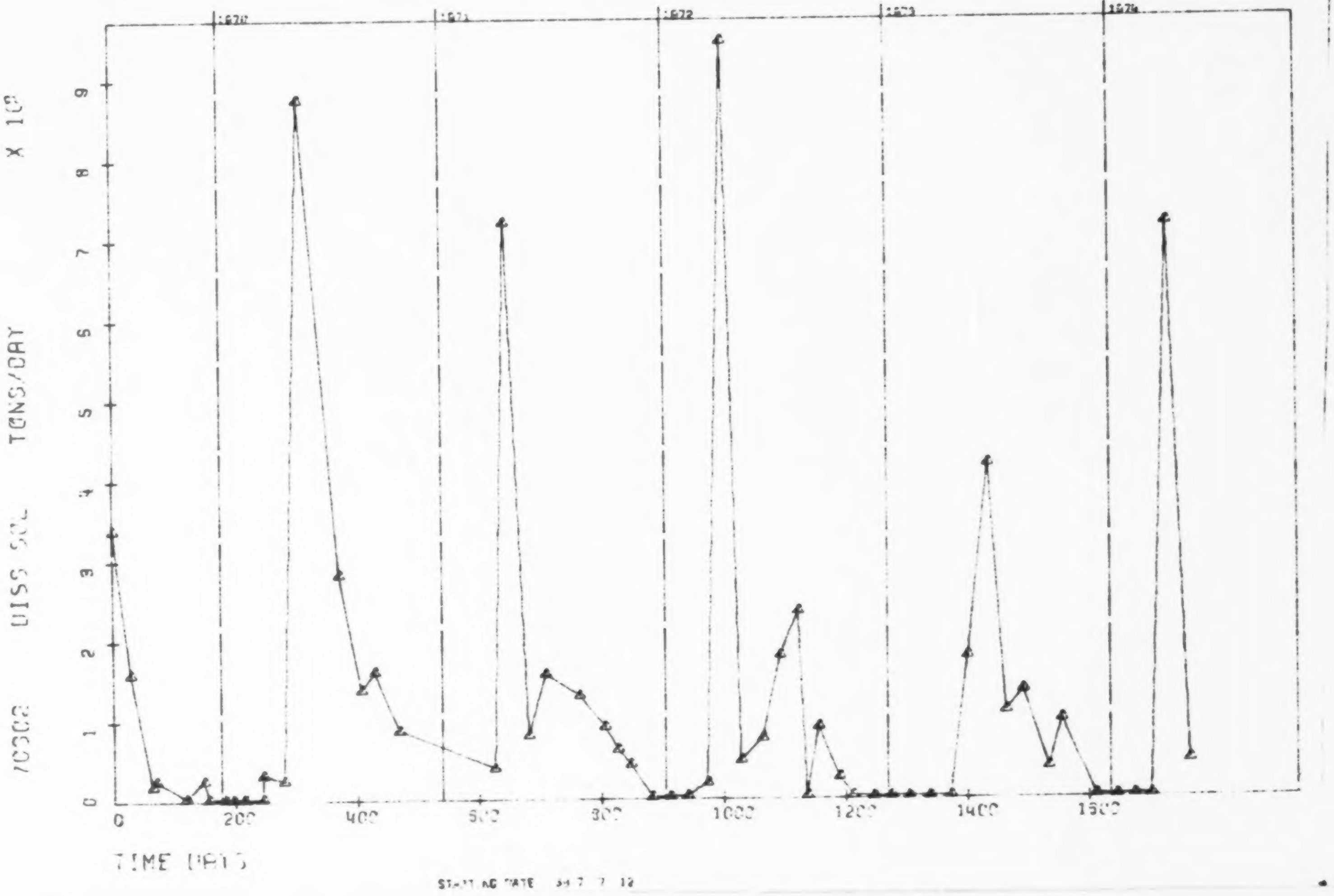
STORET
07130500
38 05 02.0 102 55 10.0
ARKANSAS RIVER BELOW JOHN MARTIN
08

Figure 1B

112WRD
2

S111204
0000 FEET DEPTH



STORET
 CR2[illegible]
 37 04 42.0 105 40 22.0
 RIO GRANDE R. NR LOBATOS, CO.
 08

112WRD 2111204
2 0000 FEET DEPTH

Figure 1C

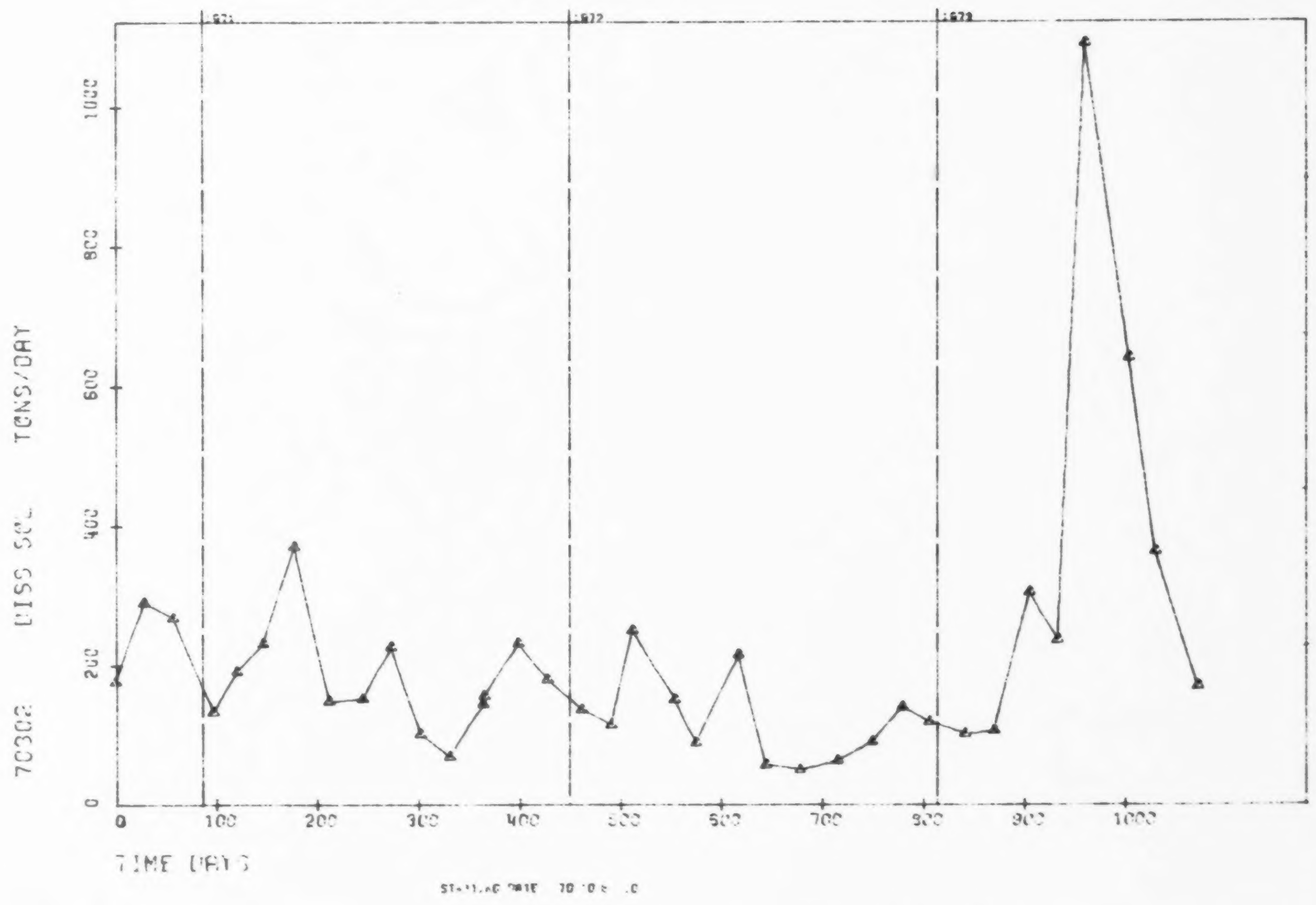


Figure 1D

STORET
06185500
48 07 24.0 104 28 30.0
MISSOURI RIVER NEAR CULBERTSON.
30

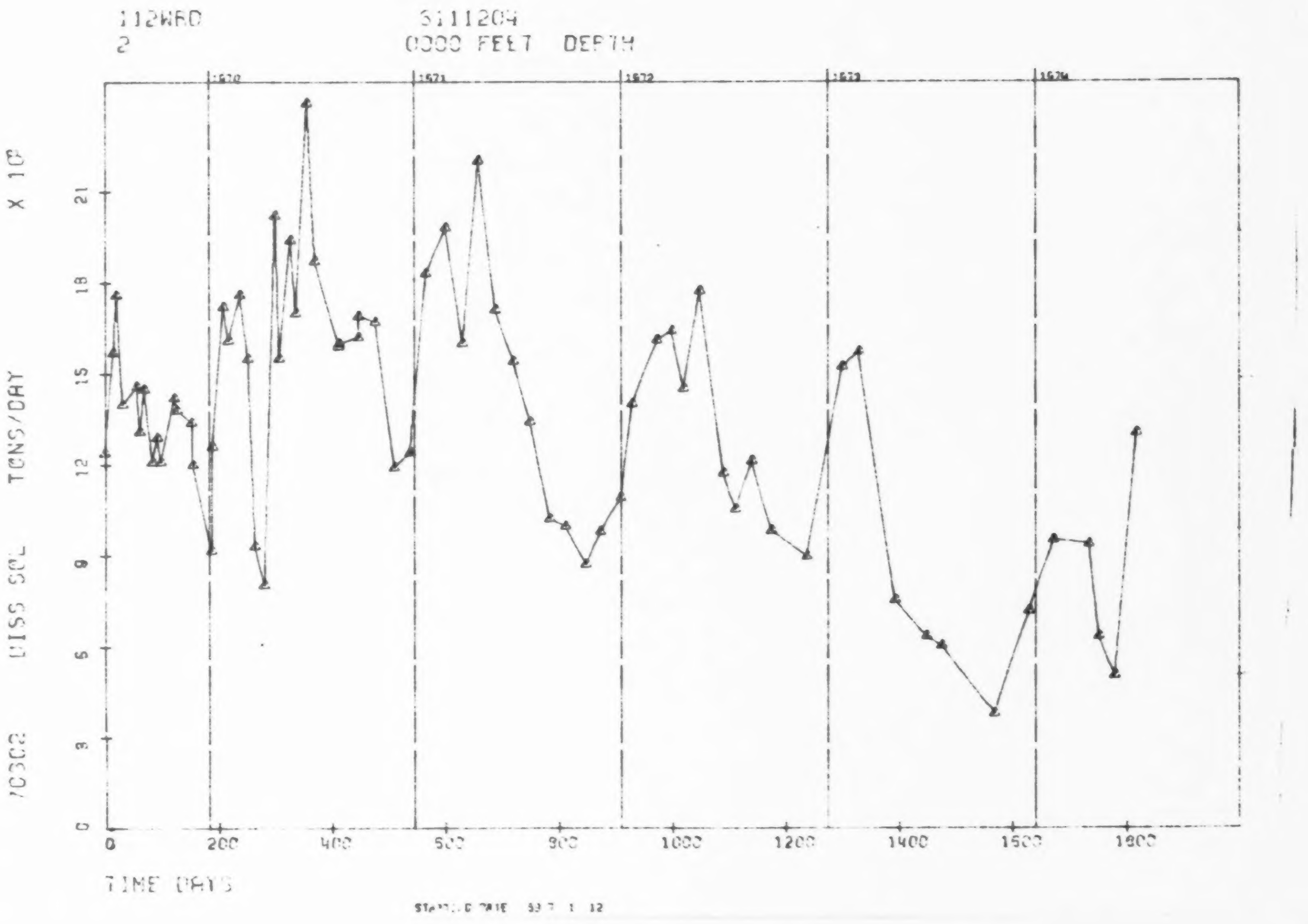
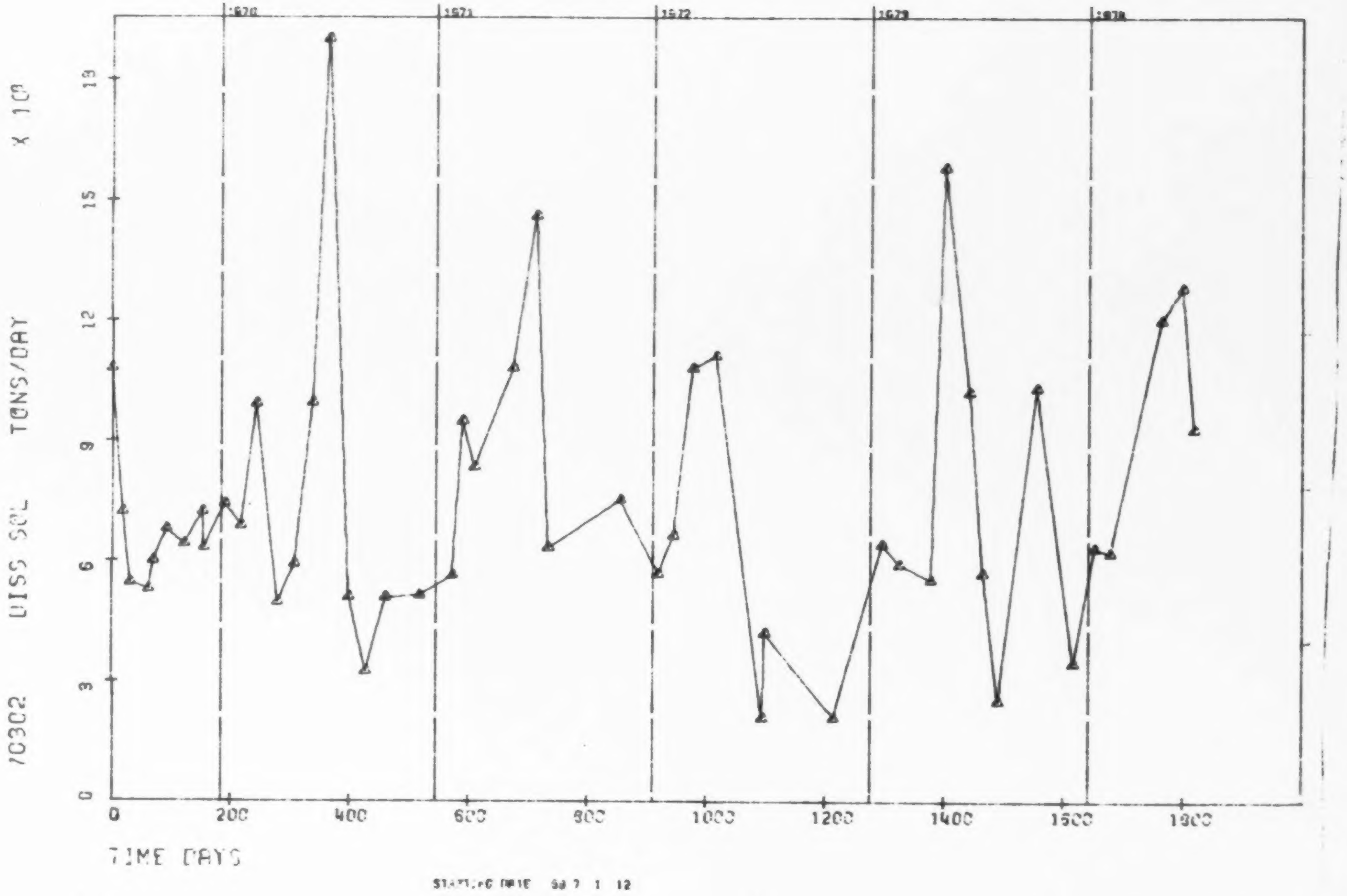


Figure 1E

STORET
06294700
45 08 50.0 107 23 00.0
BIGHORN RIVER AT BIGHORN, MT.
30

112WRD
2

5111204
0000 FEET DEPTH

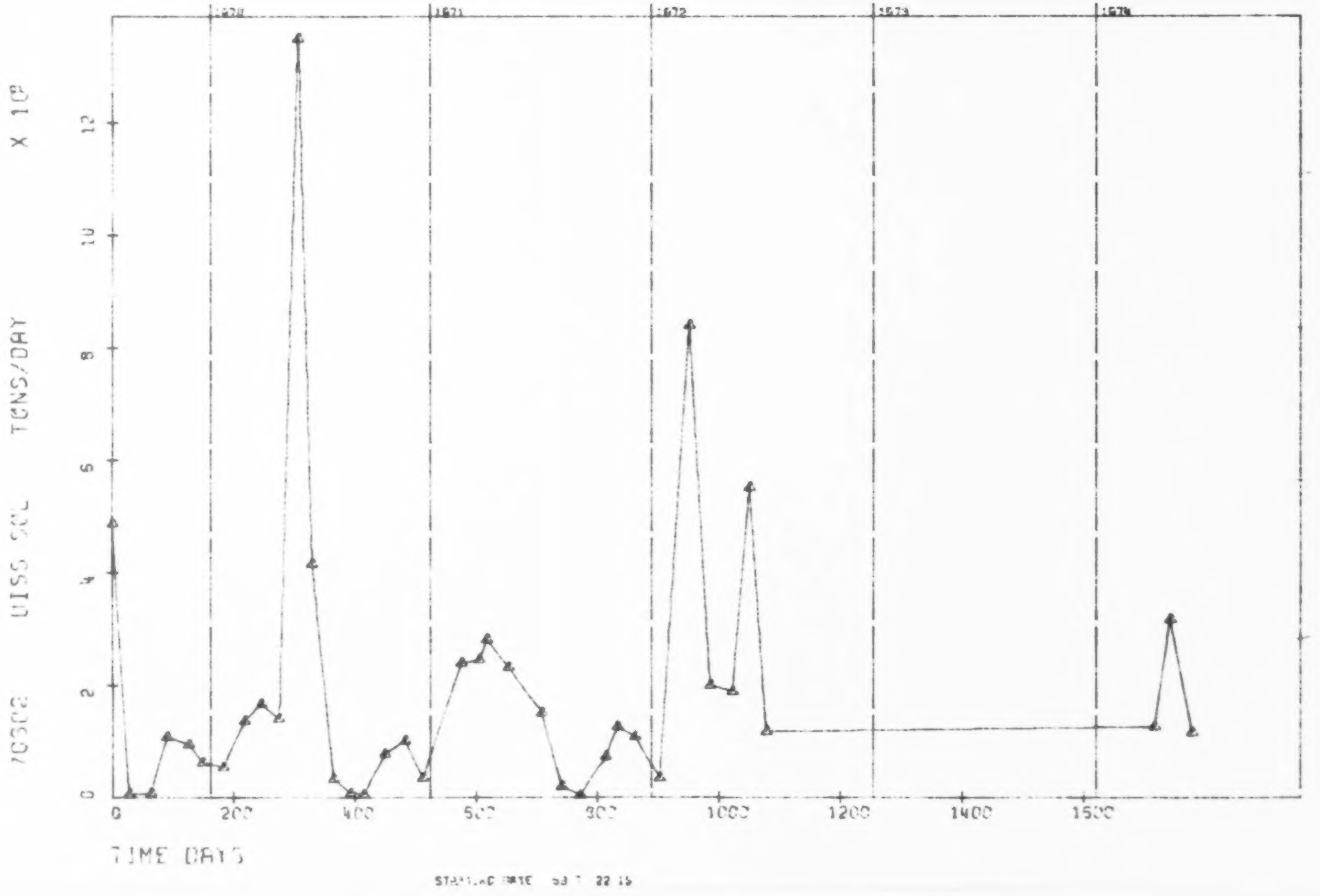


STORET
06324500
45 04 10.0 105 52 00.0
POWDER R AT MOORHEAD MONT
30

Figure 1F

112WRD
2

2111204
0000 FEET DEPTH

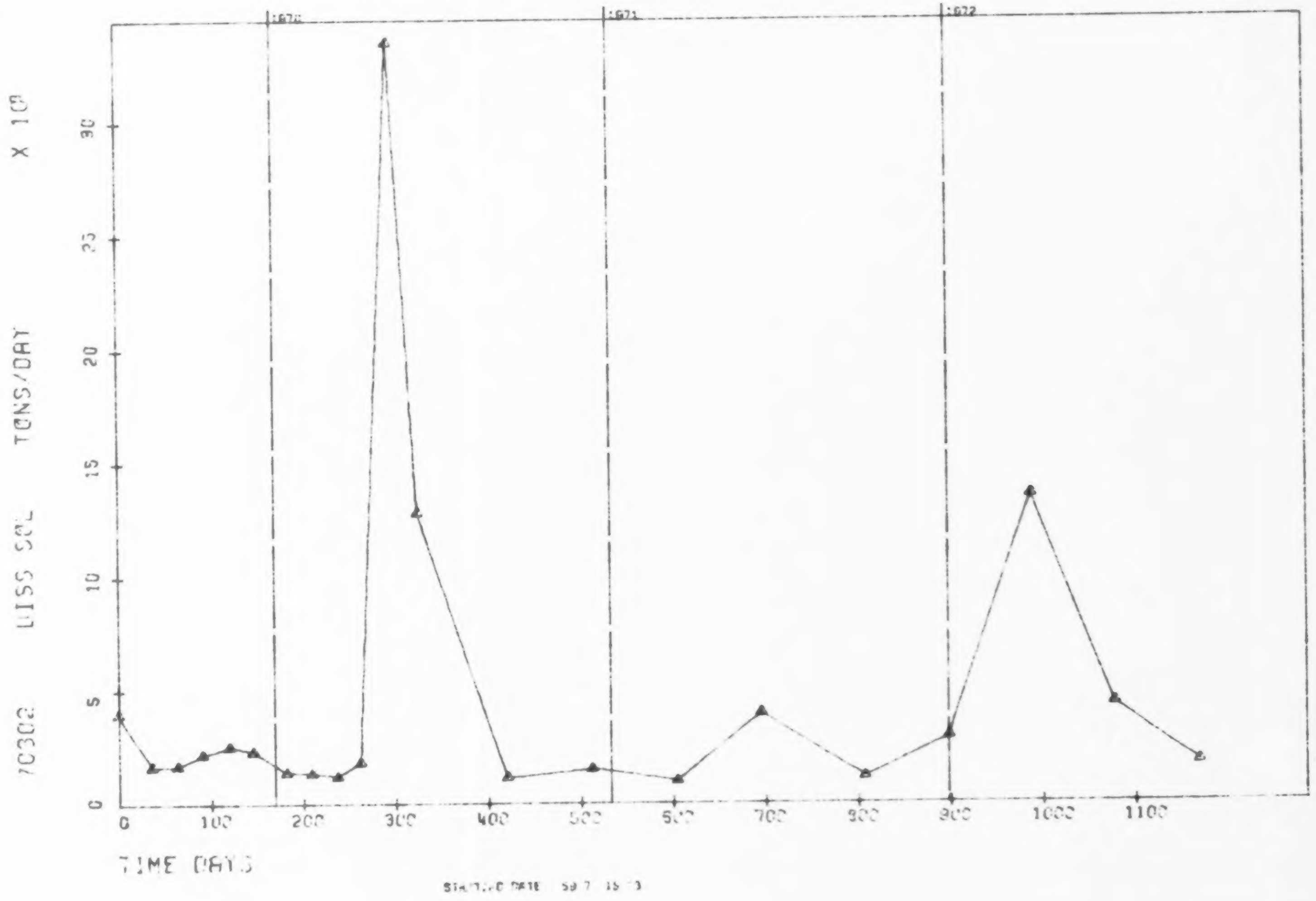


STORET
05102490
48 03 10.0 097 13 15.0
RED RIVER OF THE NORTH NEAR PEMB
38 NORTH DAKOTA

Figure 1G

112WRD
2

2111204
0000 FEET DEPTH



STORET
06467500
42 [illegible] 58.0 097 23 37.0
MISSOURI R. AT YANKTON, S.DAK.
46 SOUTH DAKOTA

CO
112WRD 2111204
2 0000 FEET DEPTH

Figure 1H

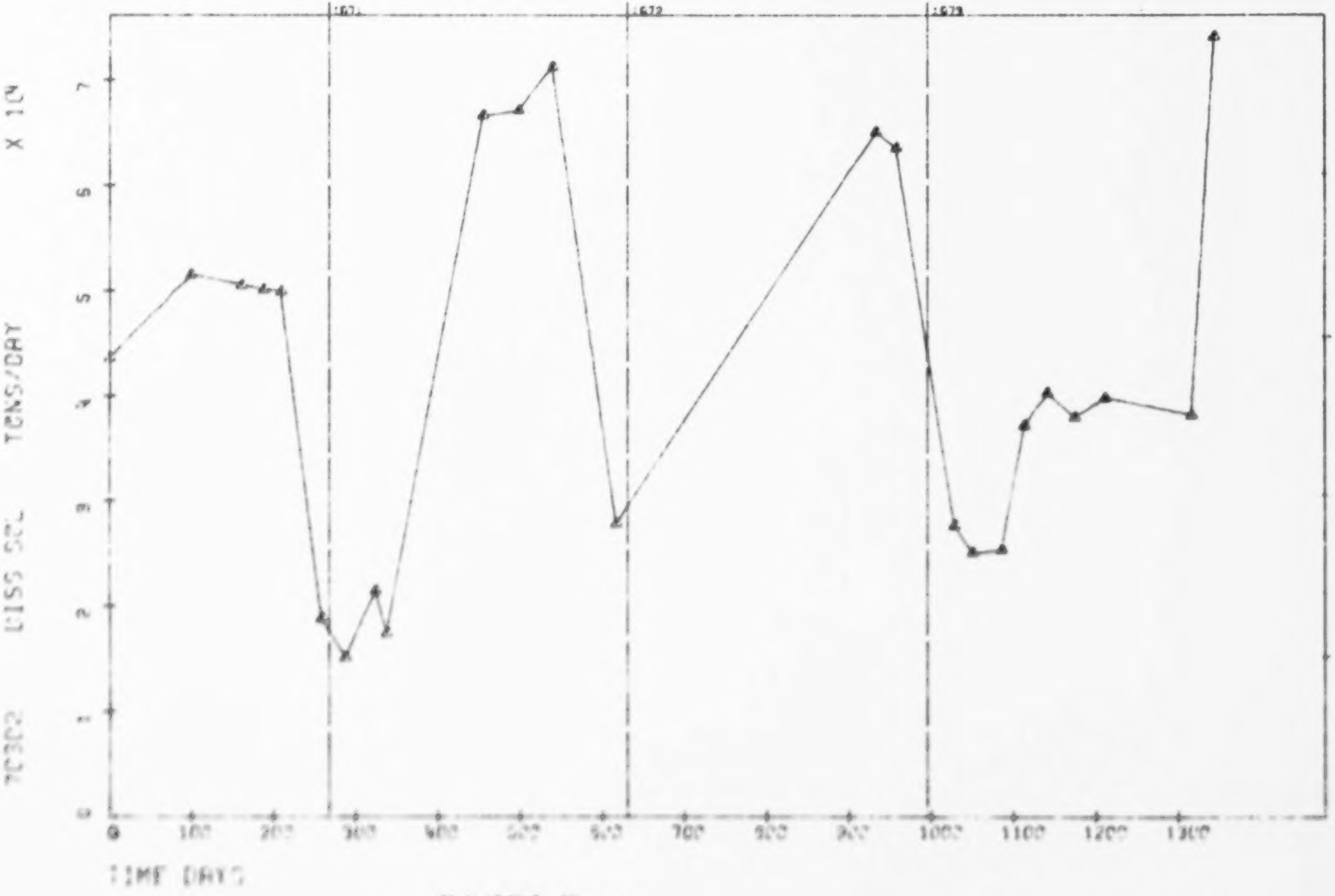


Figure 11

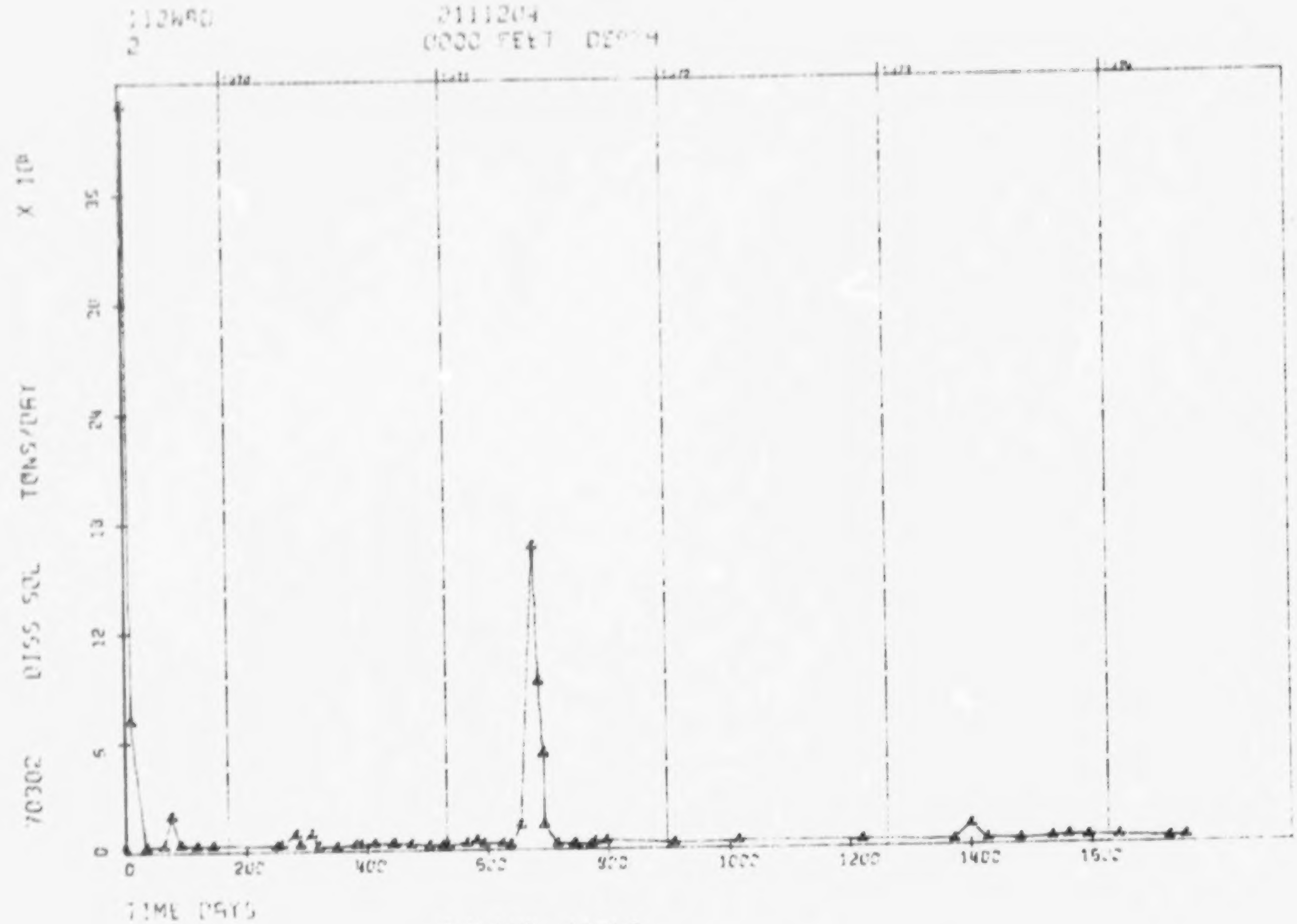

112WRD
2
2111204
0000 FEET DEPTH
70302 DISS SOL TONS/DAY X 10
0
6
12
18
24
30
36
0
200
400
600
800
1000
1200
1400
1600
TIME DAYS

Figure 1J

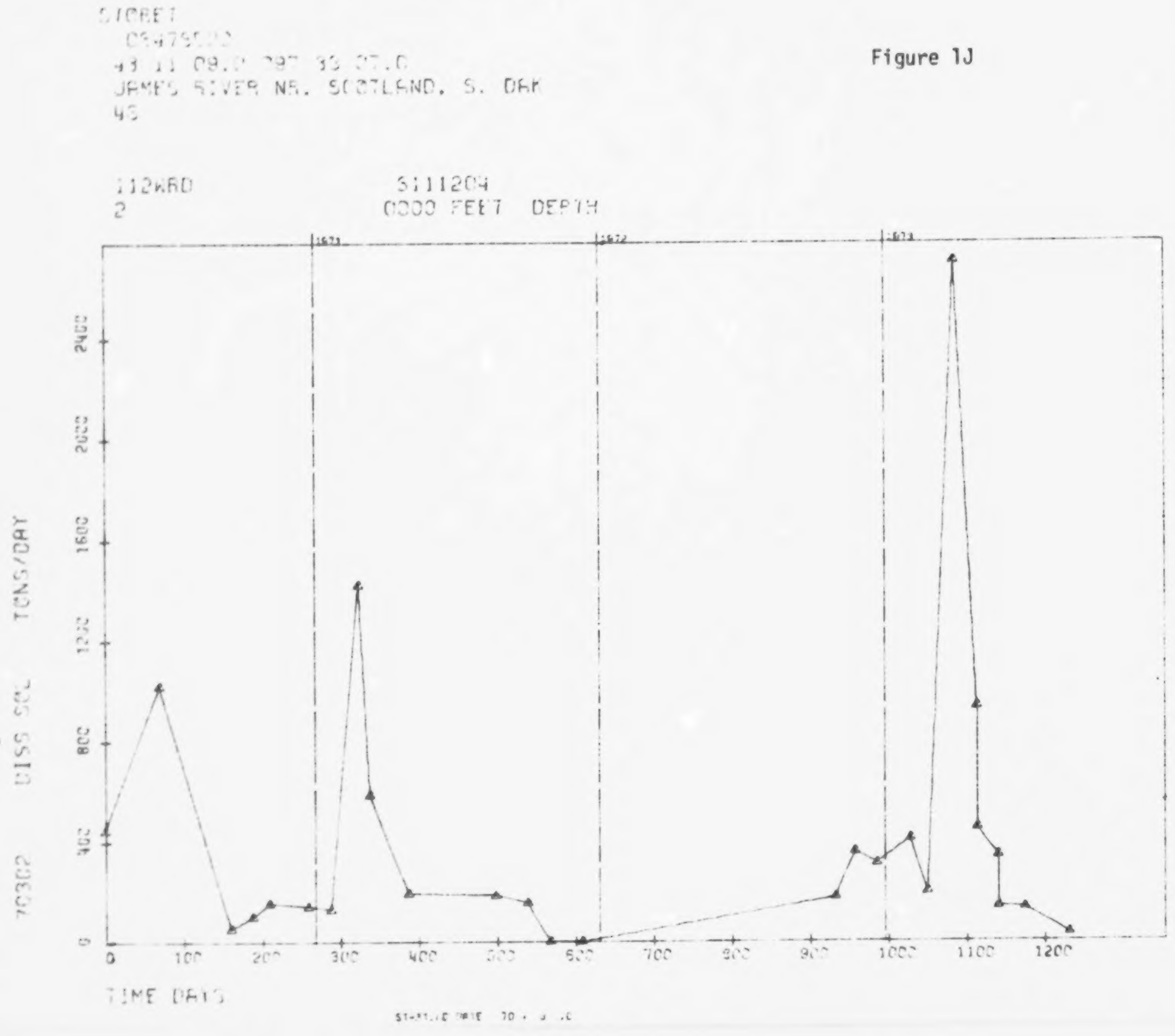
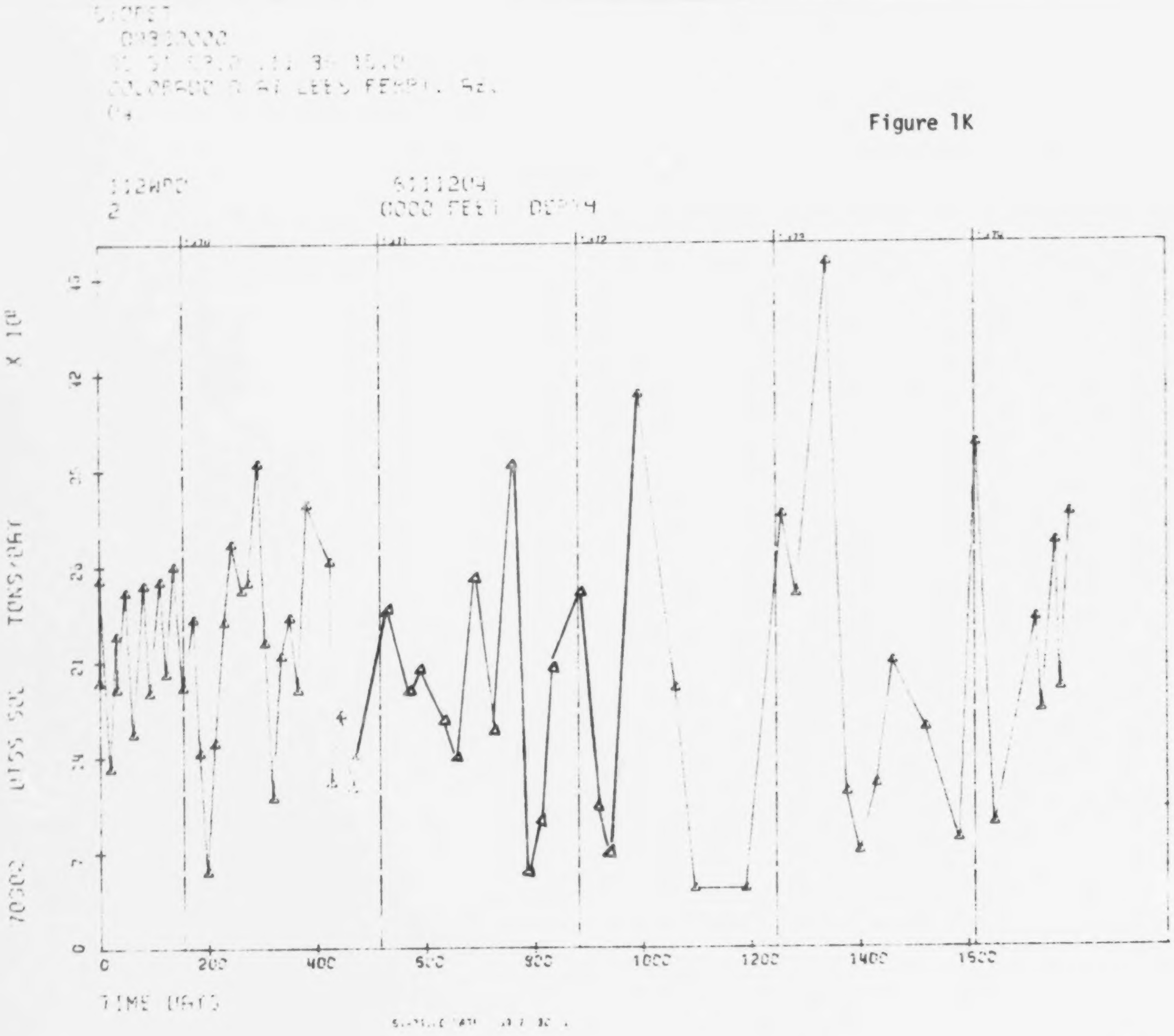

STORET
06479500
43 11 09.0 097 33 07.0
JAMES RIVER NR. SCOTLAND, S. DAK
46
112WRD
2
S111204
0000 FEET DEPTH
1971
1972
1973
70302 DISS SOL TONS/DAY
0
400
800
1200
1600
2000
2400
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
TIME DAYS

Figure 1K


STORET
09380000
COLORADO R AT LEES FERRY, AZ
112WRD
2
0000 FEET DEPTH
70300 DISS SOL TONS/DAY X 10
0
7
14
21
28
35
42
49
0
200
400
600
800
1000
1200
1400
1600
TIME DAYS

STORET
06674000
41 00 14.0 104 03 26.0
NORTH PLATTE RIVER AT MIT. NEBR.
3,

Figure 1L

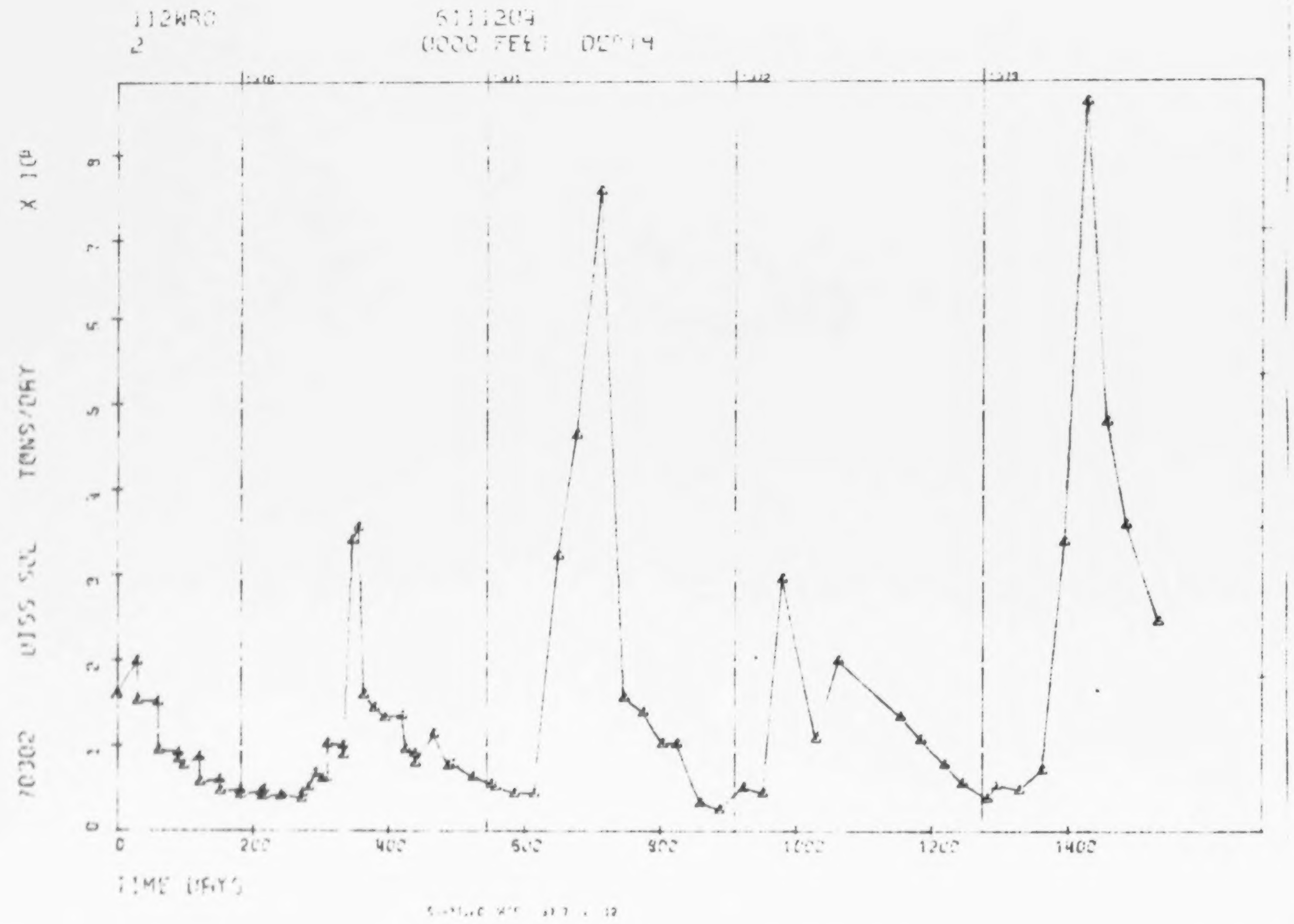
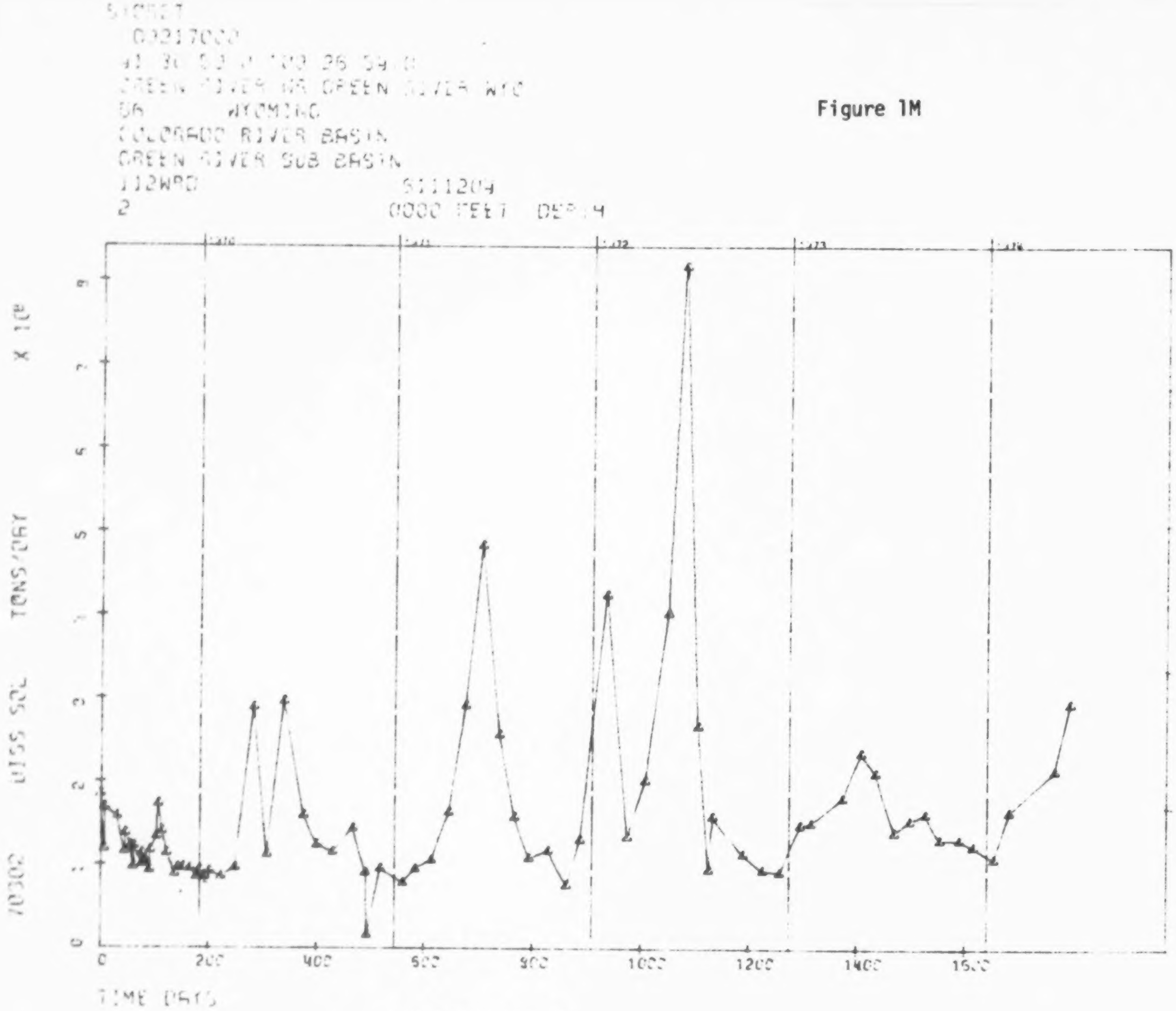


Figure 1M



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VII. General Assessment

A. Water Quality Overview.

Overall the five year trend analysis showed marked segment improvement in Colorado, and scattered successes in all other states except South Dakota. Water quality generally continues to be excellent along most segments of watercourses in Wyoming and Montana; with noteable exceptions, however, much additional improvement in data collection and availability of data are necessary to adequately document these conditions. Worsening quality on the James River in both North and South Dakota is indicated.

Statewide analysis in Colorado and Utah underscores the impact of continued poor quality on the Denver area reach of the South Platte River and the Salt Lake City reach of the Jordan River.

Regionwide analysis is somewhat misleading due to certain data anomalies, but generally, outside of the South Platte, Jordan River, and the North Platte-Casper station; D.O., BOD and Bac-T violations are infrequent across the Region. Some increased eutrophication potential is suggested by nitrogen and phosphorous data analysis. Salinity violations, the preponderant measurement of the physical aesthetic Index group are increasing. Index summary data assembled in Table 10 also suggests:

1. Reduced emphasis on oxygen related measurements in North and South Dakota;
2. Increased emphasis on Bac-T monitoring in North and South Dakota, Utah and Wyoming;

Table 10
Group-By-Group Review
of Water Quality Index Violations

1 = 6907 - 7207
2 = 7107 - 7407

	Viol./Obs.	ORB 1	ORB 2	BAC-T 1	BAC-T 2	N 1	N 2	P 1	P 2	PHY/AESTH. 1	PHY/AESTH. 2	WQI 1	WQI 2
Colorado		879/4313	1137/5342	531/2217	521/2114	412/780	751/1176	694/920	1251/1506	1144/5150	2204/7253	*28.8	*31.8
	% Violations	20	21	24	22	53	64	75	83	22	30		
Montana		1/2221	2/2081	57/415	23/349	21/681	41/428	349/531	199/387	467/4469	292/3838	6.7	5.8
	% Violations	<1	<1	14	7	3	10	66	51	10	8		
North Dakota		64/4826	44/3216	377/991	389/1226	68/513	68/513	552/608	726/790	788/7091	706/5312	11.8	11.9
	% Violations	1	1	38	32	13	13	91	92	11	13		
South Dakota		11/5445	10/3815	8/212	28/303	153/438	168/504	289/374	366/452	2248/9847	1886/5110	8.2	11.5
	% Violations	<1	<1	4	9	35	33	77	81	23	37		
Utah		335/751	275/846	394/741	351/815	142/188	180/305	126/209	195/286	244/1066	305/1486	*43.7	*36.6
	% Violations	45	33	53	42	76	59	60	68	23	21		
Wyoming		0/212	2/241	18/44	27/132	45/197	48/328	41/78	21/69	335/2878	194/2403	**11.3	** 7.7
	% Violations	0	1	41	20	23	15	53	31	12	8		
Total		1290/17768	1470/15541	1385/4620	1339/5250	841/2797	1256/3254	2051/2720	2758/3488	5226/30501	5587/25402		
		7	9	30	26	30	39	75	79	17	22		

* Data is negatively skewed by a preponderance of data along the South Platte and Jordan Rivers

** Data is negatively skewed by a data below Casper on the North Platte River.

3. Reduced emphasis on nitrogen and phosphorous related analysis in Montana;
4. Increased emphasis on nitrogen and phosphorous measurements in Colorado, South Dakota and Utah;
5. Increased emphasis on nitrogen but decreased emphasis on phosphorous in Wyoming, and increased emphasis on phosphorous measurements in North Dakota, and
6. Decreased emphasis on collection of salinity data in the physical/aesthetic group outside of Colorado and Utah.

Increased emphasis on monitoring, in general, is seen in Colorado and Utah, but much reduced STORET data availability is highlighted in Montana.

B. Segment Trend Analysis.

Segment trends on a state-by-state basis highlight five of nine significantly improved segments in Colorado, two of 14 in Montana, one of four in North Dakota, none of 11 in South Dakota, three of 10 in Utah and none of four in Wyoming. Some decline in quality is seen on one segment each in North and South Dakota and Colorado (subsegmenting showed improvement in the middle and lower reach of this Colorado watercourse). No significant change was observed in two excellent or near excellent segments in Colorado, five excellent segments in Montana, and one each excellent segment in North and South Dakota. Little change was detected at two marginal segments in Montana and South Dakota and one each marginal segment in Utah and Wyoming. One each poor to bad rated segment in North Dakota, South Dakota and Utah showed little change. Trend analysis was not possible on one segment in Colorado, five segments in Montana, six in South Dakota, five in Utah and three of four in Wyoming. Wyoming and North Dakota had only one set of standards for each entire watercourses analyzed.

With the exception of two excellently rated lakes in Colorado no trends were assessable on other lakes in the region.

Trend analysis is summarized in Table 11 along with the projected state use changes and 1983 goal projections summarized earlier in Section I. A complete breakdown of violations versus total observations in each Water Quality Index group for each segment is provided in Appendix 2.

Table 11

Water Quality Summary

State	Watercourse	Present Quality*and Uses **			Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
Colorado	S. Platte R. Fairplay to Exposition Ave.	5	UM CF	B-1	13 to 5	No Change/ Yes
	From Exposition Ave. to State Line (Nebr.)	47	UM WF	B-2	43 to 47	State of Colorado is considering downgrading much of this segment/ Doubtful in upper reach
	Colorado R. Headwaters to Grand Valley	3	UM CF	B-1	8 to 3	No Change/ Yes
	From Grand Valley to State Line (Utah)	11	UM WF	B-2	24 to 11	No Change/ Probable
	Arkansas R. Headwaters to Canon City	2	UM CF	B-1	6 to 2	No Change/ Yes
	From Canon City to State Line (Kansas)	13	UM WF	B-2	20 to 13	State of Colorado is considering downgrading WF Classification in this segment, from Pueblo to State Line/doubtful Middle & Lower Reach
	Rio Grande R. Headwaters to State Line (New Mexico)	5	UM CF	B-1	8 to 5	Change from B-1 to B-2 being considered for lower reaches in this segment/Yes, if changed in lower reach.
	Green R.	4	UM CF	B-1	NR to 4	No Change/ Probable

* Based on 1971 - 1974 data

** Uses correspond to State use designations

Explanatory notes on last page

Table 11

State	Watercourse	Present Quality*and Uses	Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
Colorado	North Platte R.	5 B-1 UM CF	8 to 5	No Change/ Probable
	Carter Res.	3 A-1 UM CF	2 to 3	No Change/ Yes
	Horsetooth Res.	3 A-1 WM CF	2 to 3	No Change/ Yes
Montana	Missouri River Headwaters to Sun R.	6 B,D1 UM CF (Incl. Salmonid)	NR to 6	No Change/ Probable
	From Sun R. to Rainbow Dam	ND B,D2 UM CF (Incl. Salmonid - Marginal)	ND to ND	No Change/ Questionable
	From Rainbow Dam to Ft. Peck Dam	2 B,D3 UM CF (Non-Salmonid)	3 to 2	No Change/ Probable
	From Ft. Peck Dam to Milk R.	NR B,D2 UM CF (Incl. Salmonid - Marginal)	NR to NR	No Change/ Probable
	From Milk R. to State Line (N. Dakota)	2 B,D3 WM CF (Non-Salmonid)	4 to 2	No Change/ Probable

Table 11

State	Watercourse	Present Quality*and Uses	Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
Montana	Bighorn R. WY. to Williams Coulee	NR B,D1 UM CF (Incl. Salmonid)	4 to NR	No Change/ Probable
	Williams Coulee to Yellowstone	6 B,D2 UM CF (Incl. Salmonid - Marginal)	11 to 6	No Change/ Probable
	Yellowstone R. Yellowstone Park to Laurel WTP.	2 B,D1 UM CF (Incl. Salmonid)	3 to 2	No Change/ Yes
	From Laurel WTP to Billings WTP	3 B,D2 UM CF (Incl. Salmonid - Marginal)	5 to 3	No Change/ Yes
	From Billings WTP to State Line (N. Dakota)	8 B,D3 UM CF (Non-Salmonid)	8 to 8	No Change/ Questionable
	Clark Fork R. Warm Spgs. to Cottonwood Cr.	13 C,D2 GA LM(Not drinking) CF(Incl. Salmonid - Marginal)	9 to 13	No Change/ Questionable
	From Cottonwood Cr. to Little Blackfoot R.	NR C,D1 GA LM(Not drinking) CF(Incl. Salmonid)	16 to NR	No Change/ Questionable

Table 11

State	Watercourse	Present Quality* and Uses	Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
Montana	From Little Black Foot R. to State Line (Idaho)	2 B,D1 UM CF(Incl. Salmonid)	4 to 2	No Change/ Yes
	Powder R.	9 B,D3 UM CF(Non-Salmonid)	18 to 9	No Change/ Probable
	Lake Koocanusa	3 A (open), D1 UM CF	ND to 3	No Change/ Yes
	Flathead Lake	NR B,D1 UM CF	2 to NR	No Change/ Yes
North Dakota	Missouri R.	2 I UM Native Fish	3 to 2	No Change/ Yes
	Souris R.	19 IA LM (UM with softening) Native Fish	18 to 19	No Change/ No
	Red River	12 I UM Native Fish	18 to 12	No Change/ Questionable
	James River	23 IA LM (UM with softening) Native Fish	18 to 23	No Change/ No

Table 11

State	Watercourse	Present Quality*and Uses		Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
South Dakota	Missouri R. S.D. to Big Bend Dam	5	1,2,7,8 9,10,11 UM CF (Permanent)	NR to 5	No Change/ Yes
	From Big Bend Dam to State Line (Iowa)	4	1,4,7,8, 9,10,11 UM WF (Permanent)	4 to 4	No Change/ Yes
	Cheyenne R. WY to Angostura Dam	14	5,8,9,10, 11 LM WF (Semi-permanent)	18 to 14	No Change/ No
	From Angostura Dam to Fall R.	NR	4,7,8,9, 10,11 LM(Not drinking) WF (Permanent)	NR to NR	No Change/ Probable
	From Fall R. to Missouri R.	7	5,7,8, 9,10,11 LM(Not drinking) WF (Semi-permanent)	9 to 7	No Change/ Questionable
	Big Sioux R. Headwaters to Sioux Falls	13	1,5,8, 9,10,11 LM(Limited contact) WF (Semi-permanent)	NR to 13	Segment near Watertown could be changed to marginal or non-fishing/ Probable
	From Sioux Falls to Klondike Dam	22	5,8,9,10,11 LM WF (Semi-permanent)	NR to 22	No Change/ Probable

Table 11

State	Watercourse	Present Quality*and Uses	Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
South Dakota	From Klondike Dam to State Line (Nebr.)	33 5,7,8, 9,10,11 LM (Not drinking) NF (Semi-permanent)	NR to 33	No Change/ Probable
	James R. N.D. to Diversion Dam	12 5,8,9,10,11 LM WF (Semi-permanent)	11 to 12	No Change/ Questionable
	From Diversion Dam to Huron	ND 1,5,8, 9,10,11 LM (Limited contact) WF (Semi-permanent)	ND to ND	No Change/ Questionable
	From Huron to Missouri R.	21 5,8,9,10,11 LM WF (Semi-permanent)	14 to 21	No Change/ Questionable
	Big Stone Lake	6 4,7,8,9,10 UM WF (Permanent)	NR to 6	No Change/ Probable
	Lake Frances Case	ND 1,2,7, 8,9,11 UM CF (Permanent)	NR to ND	No Change/ Probable
	Oahe Res.	NR 1,4,7, 8,9,11 UM WF (Permanent)	NR to NR	No Change/ Probable

Table 11

State	Watercourse	Present Quality*and Uses		Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
Utah	Jordan R. Utah lane to Utah County Line	12	CW LM (For drinking) WF	NR to 12	No Change/ Probable but depends on Utah Lake in upper reach
	From County Line to Great Salt Lake	54	CC LM (For drinking) CF	63 to 54	No Change/ Doubtful
	Colorado R.	15	CW LM (For drinking) WF	32 to 15	No Change/ Questionable
	Bear R. Headwaters to WY	ND	CC LM (For drinking) CF	ND to ND	No Change/ Questionable
	UT to WY	ND	CC LM (For drinking) CF	ND to ND	No Change/ Questionable
	Idaho to GSL	18	CW LM (For drinking) WF	32 to 18	No Change/ Probable
	Weber R. Headwaters to highway 40	10	CC LM (For drinking) CF	21 to 10	No Change/ Probable - Questionable in lower reach
	Highway 40 to GSL	NR	CW LM (For drinking) WF	NR to NR	No Change/ No
	Green R. from Flaming Forge to Colorado	7	CC LM (For drinking) CF	NR to 7	No Change/ Yes
	State of Colorado to Colorado R.	11	CW LM (For drinking) WF	9 to 11	No Change/ Probable

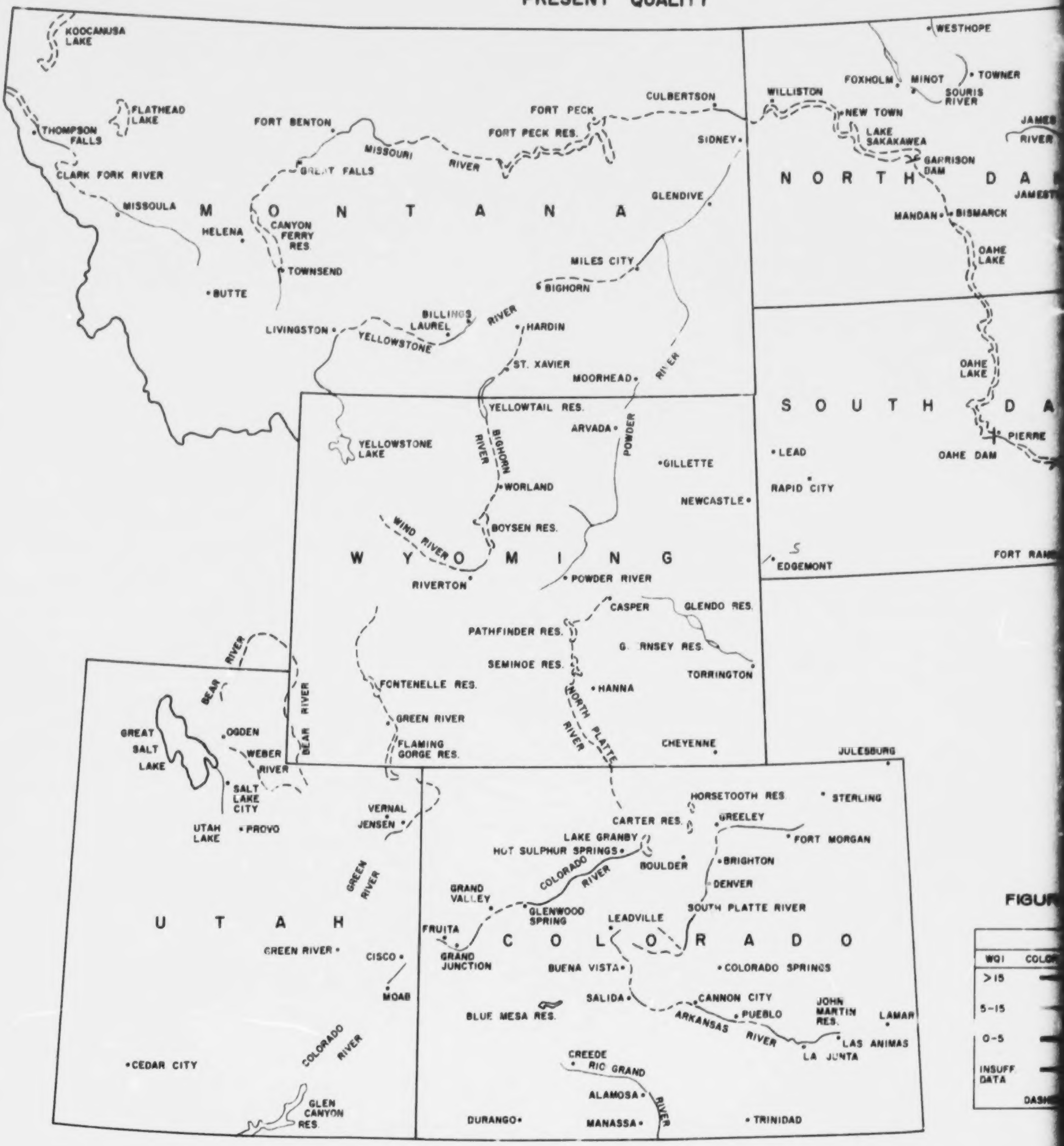
Table 11

State	Watercourse	Present Quality*and Uses		Changes In Past Five Years	Projected Changes In State Classification/ Will 1983 Goals Be Met?
Utah	Utah Lake	ND	C LM (For drinking) Fish Propagation & perpetuation	NR to ND	No Change/ Doubtful
Wyoming	N. Platte R.	10	I CF WF (Natural Game Fish)	12 to 10	No Change/ Questionable below Casper
	Wind-Bighorn	3	I CF WF (Natural Game Fish)	NR to 3	No Change/ Questionable
	Green R.	1	I CF WF (Natural Game Fish)	NR to 1	No Change/ Yes
	Powder R.	10	I CF WF (Natural Game Fish)	NR to 10	No Change/ Questionable

Note: Ratings are not directly comparable except for the same classification in the same State; however, for general use 0 - 5 excellent; 5 - 15 good to fair; 15 - 100 poor to worst.

UM - Unlimited Man -- Full body contact recreation and for drinking
LM - Limited Man -- Either limited or no contact recreation and/or not for drinking
CF - Cold Fish -- Including fish propagation, except as noted
WF - Warm Fish -- Including fish propagation, except as noted
NR - Not Rateable
ND - No Data

PRESENT QUALITY



KOOCANUSA LAKE
FLATHEAD LAKE
THOMPSON FALLS
CLARK FORK RIVER
MISSOULA
FORT BENTON
GREAT FALLS
MISSOURI RIVER
FORT PECK
FORT PECK RES.
CULBERTSON
SIDNEY
GLENDIVE
M O N T A N A
HELENA
CANYON FERRY RES.
TOWNSEND
BUTTE
MILES CITY
BIGHORN
BILLINGS
LAUREL
LIVINGSTON
YELLOWSTONE RIVER
HARDIN
ST. XAVIER
MOORHEAD
POWDER RIVER
YELLOWTAIL RES.
YELLOWSTONE LAKE
BIGHORN RIVER
ARVADA
GILLETTE
WORLAND
NEWCASTLE
BOYSEN RES.
WIND RIVER
W Y O M I N G
RIVERTON
POWDER RIVER
CASPER
GLENDO RES.
PATHFINDER RES.
GUERNSEY RES.
SEMINOE RES.
TORRINGTON
HANNA
FONTENELLE RES.
GREEN RIVER
NORTH PLATTE RIVER
FLAMING GORGE RES.
CHEYENNE
BEAR RIVER
BEAR RIVER
GREAT SALT LAKE
OGDEN
WEBER RIVER
SALT LAKE CITY
UTAH LAKE
PROVO
VERNAL
JENSEN
GREEN RIVER
U T A H
GREEN RIVER
CISCO
MOAB
CEDAR CITY
COLORADO RIVER
GLEN CANYON RES.
JULESBURG
HORSETOOTH RES.
STERLING
CARTER RES.
GREELEY
FORT MORGAN
LAKE GRANBY
HOT SULPHUR SPRINGS
BOULDER
BRIGHTON
COLORADO RIVER
DENVER
GRAND VALLEY
GLENWOOD SPRING
LEADVILLE
SOUTH PLATTE RIVER
FRUITA
GRAND JUNCTION
C O L O R A D O
BUENA VISTA
COLORADO SPRINGS
SALIDA
CANNON CITY
PUEBLO
JOHN MARTIN RES.
LAMAR
BLUE MESA RES.
ARKANSAS RIVER
LAS ANIMAS
LA JUNTA
CREEDE
RIO GRANDE RIVER
ALAMOSA
DURANGO
MANASSA
TRINIDAD
WESTHOPE
FOXHOLM
MINOT
TOWNER
SOURIS RIVER
WILLISTON
NEW TOWN
JAMES RIVER
LAKE SAKAKAWEA
GARRISON DAM
N O R T H D A
JAMEST
MANDAN
BISMARCK
OAHE LAKE
OAHE LAKE
S O U T H D A
PIERRE
LEAD
OAHE DAM
RAPID CITY
EDGEMONT
FORT RAN
FIGUR
WQI
COLO
>15
5-15
0-5
INSUFF. DATA
DASH

A

PRESENT QUALITY

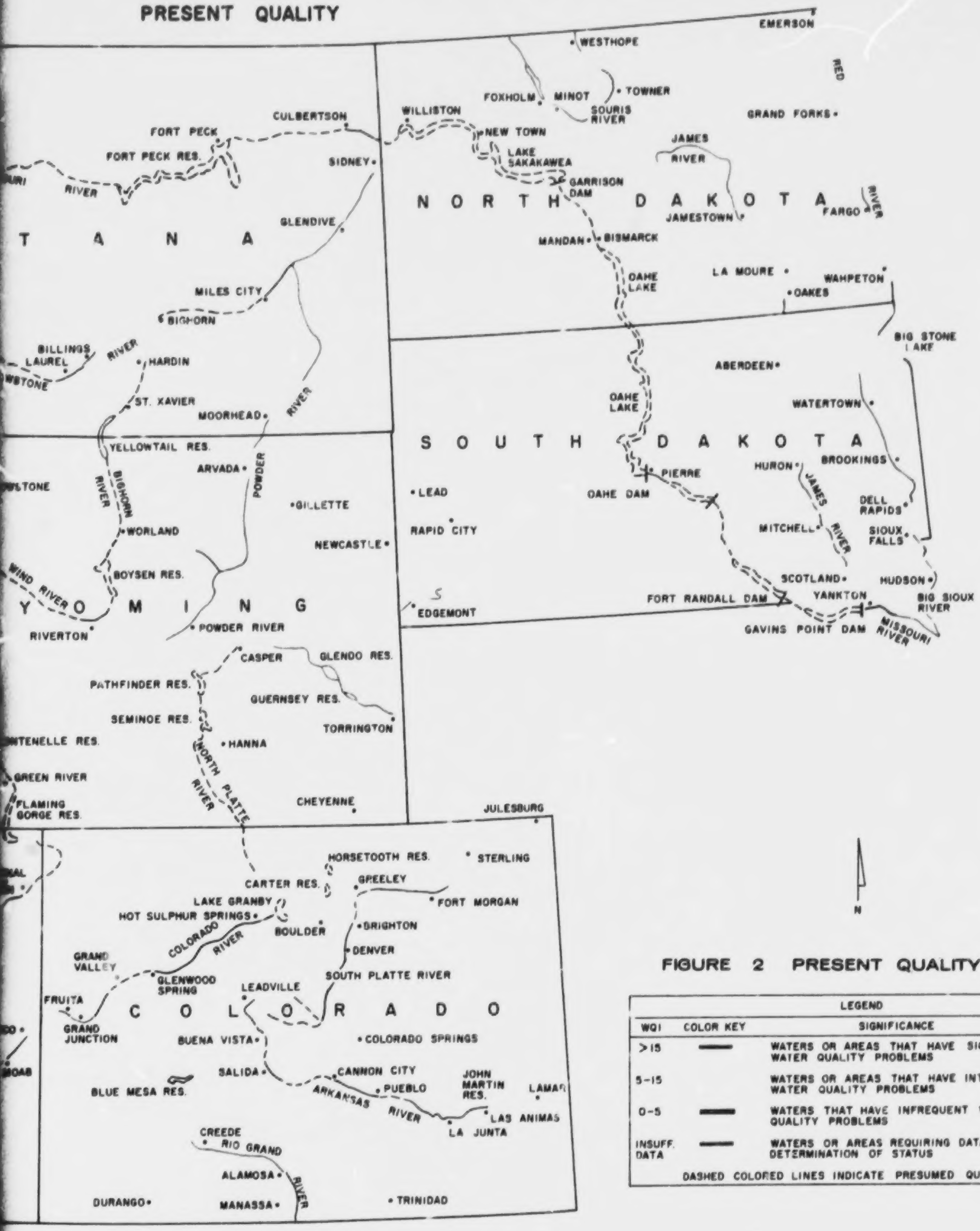

EMERSON
WESTHOPE
RED
TOWNER
FOXHOLM
MINOT
SOURIS RIVER
GRAND FORKS
WILLISTON
NEW TOWN
LAKE SAKAKAWEA
GARRISON DAM
JAMES RIVER
CULBERTSON
FORT PECK
FORT PECK RES.
SIDNEY
RIVER
NORTH DAKOTA
JAMESTOWN
FARGO
RIVER
MANDAN
BISMARCK
GLENDIVE
TANA
OAHE LAKE
LA MOURE
WAHPETON
OAKES
MILES CITY
BIGHORN
BIG STONE LAKE
BILLINGS
LAUREL
RIVER
HARDIN
ABERDEEN
WSTONE
ST. XAVIER
OAHE LAKE
WATERTOWN
MOORHEAD
RIVER
SOUTH DAKOTA
YELLOWTAIL RES.
ARVADA
POWDER
HURON
BROOKINGS
PIERRE
USTONE
BIGHORN RIVER
LEAD
OAHE DAM
JAMES
GILLETTE
DELL RAPIDS
WORLAND
RAPID CITY
MITCHELL
RIVER
SIOUX FALLS
NEWCASTLE
BOYSEN RES.
SCOTLAND
HUDSON
WIND RIVER
YOMING
FORT RANDALL DAM
YANKTON
BIG SIOUX RIVER
EDGEMONT
RIVERTON
POWDER RIVER
GAVINS POINT DAM
MISSOURI RIVER
CASPER
GLENDO RES.
PATHFINDER RES.
GUERNSEY RES.
SEMINOE RES.
TORRINGTON
NTENELLE RES.
HANNA
NORTH PLATTE RIVER
GREEN RIVER
FLAMING GORGE RES.
CHEYENNE
JULESBURG
HORSETOOTH RES.
STERLING
CARTER RES.
GREELEY
FORT MORGAN
LAKE GRANBY
HOT SULPHUR SPRINGS
BOULDER
BRIGHTON
COLORADO RIVER
DENVER
GRAND VALLEY
GLENWOOD SPRING
SOUTH PLATTE RIVER
LEADVILLE
FRUITA
COLORADO
GRAND JUNCTION
BUENA VISTA
COLORADO SPRINGS
SALIDA
CANNON CITY
JOHN MARTIN RES.
LAMAR
BLUE MESA RES.
PUEBLO
ARKANSAS RIVER
LAS ANIMAS
LA JUNTA
CREEDE
RIO GRAND
ALAMOSA
RIVER
DURANGO
MANASSA
TRINIDAD
MOAB
N

FIGURE 2 PRESENT QUALITY MAP

LEGEND

WQI	COLOR KEY	SIGNIFICANCE
>15	▬	WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15		WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5	▬	WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
INSUFF. DATA	▬	WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS

DASHED COLORED LINES INDICATE PRESUMED QUALITY

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C. Current Conditions.

Graphically the need for data is shown in Figure 2 by green and dashed colored lines. Other highlights of this presentation are the red areas in Colorado, North and South Dakota and Utah; generally near population centers, and the absence of red lines in Montana and Wyoming. Continued abatement efforts are suggested along both the red and yellow segments in each state.

Breadth of data coverage is suggested by Index rateability in both trend periods. Data for Colorado and North Dakota indicates good coverage whereas Wyoming and South Dakota has limited data coverage "across-the-board". Breadth of coverage in Montana and Utah is mixed with less than 30 percent of the data-rich stations rateable in both periods. All states show improvement in rateability in the second period.

Very limited water quality flow-tied trend data is available as shown by only 31 of 342 data-rich stations with mean flow data and rateability in both periods. Water Quality Flow Coupled Data coverage is fair in Colorado and North Dakota and poor in the remaining Region VIII states. A state-by-state breakdown is given in Table 12.

TABLE 12

Station-By-Station Index Rateability Review

State	Data Ricn	Rateable Both periods	 2nd period	Rateable with mean flow in both periods
Colorado	65	38	42	10
Montana	35	9	15	4
N. Dakota	42	24	27	8
S. Dakota	27	4	13	4
Utah	49	11	20	3
Wyoming	24	2	8	2
Total	242	87	125	31

D. State-By-State Breakdown of Key Watercourses.

A general overview of each state-use segment is given below. Station by station mean flow and Index analysis within each segment is provided in Appendix 3.

1. Colorado.

a. (1) South Platte River from Fairplay to Exposition Avenue.

The South Fork is dominated by three major impoundments with flow augmented by intermittent transmountain diversions from the Colorado River basin. There is large scale use for irrigation with seasonal return flows from irrigated areas. The North Fork is dominated by transmountain diversions from the Colorado River basin. There are some small scale uses for irrigation. The South Platte River below South Platte is dominated by diversions to the Denver Water Board's Storage Reservoirs and construction of Chatfield Dam (now filling). There is one major explosives related industry and an aerospace plant located on tributaries and two major STP's on the mainstem between Littleton and Exposition Avenue.

D.O. and BOD data were unavailable at the North and South Fork stations and were also missing at the Denver Water Board Intake. Nitrogen data was unavailable at Bowles Avenue and Dartmouth Avenue.

A segment rating of 5 - down from 13 - reflects a significant decline in violations. Improvement along this segment is due largely to decreased D.O. violations above Littleton and reductions in D.O. and Bac-T violations at Dartmouth Avenue. There is some increase in salinity violations at Dartmouth Avenue. Flouride violations were also noted on both the North and South Forks. Phosphorous is generally abundant along this segment and nitrogen is abundant at Littleton and presumably downstream to Exposition Avenue.

Severe events were noted along the segment in both periods, most noteably due to zinc and copper (especially at the Marston Lake Station), and mercury. There were no reported fish kills, salinity, pH, or PHS violations.

Group-by-group violations analysis shows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	Dissolved Oxygen & BOD (ORB)	11.8	1.8
II.	Total & Fecal Coliform (Bac-T)	8.0	1.9
IIIa.	Nitrogen	48.5	27.4
IIIb.	Phosphorous	78.2	78.7
IV.	Phys./Aesth.	5.3	5.4

a.(2) South Platte River from Exposition Avenue to the (Nebraska) Stateline.

The upstream end of the upper reach is directly affected by three mainstem STP's, three mainstem power-plant withdrawals and partial returns, a major rubber belt and hose industry, a major STP on a tributary, urban runoff, seasonal diversions to the irrigation ditches and numerous sand and gravel operations. The lower upstream reach is affected by four major STP's including a 140 million gallon per day plant, one mainstem (seasonal) and five tributary (four-seasonal) discharges from sugar refineries, twelve major STP tributary discharges, numerous feedlots, significant irrigation diversions and return flows and groundwater withdrawal There are two major molybdenum mines (one-seasonal) and other mine drainage along with a large brewery further downstream on Clear Creek. Also, one uranium mine and one nuclear materials processing industry is located in the Basin. In addition, one nuclear power plant has a seasonal discharge to the mainstem in the lower reach. The lower reach below Kersey is affected by three major mainstem STP's, three mainstem (seasonal) sugar refineries, feedlots, significant irrigation diversions above Balzac and Julesburg and several storage reservoirs along the segment.

Data is generally good throughout the segment although no water quality stations pinpoint individual tributary impact (except Clear Creek's). Data at Sterling is limited. No flow data is available between 19th Street and Henderson. There is no nitrogen data from Exposition Avenue to the Denver Metro outfall.

Index data from Alameda Avenue to Henderson indicates a decline from 42 to 49 whereas significant improvement was seen from 36 to 25 in the subsegment from Kersey to Julesburg. Overall a decline in quality from 43 to 47 is indicated for the entire segment. Especially

c. Colorado River Headwaters to Grand Valley.

Headwaters are affected by diversion from Grand Lake, to the South Platte basin and storage in lakes Granby and Shadow Mountain (manmade). Quality is also affected by significant transmountain diversions to the South Platte basin, diversions for irrigation, numerous storage reservoirs on tributaries, seasonal tourism, mine drainage into tributaries, mineralized springs, and one major zinc refining industry on a tributary.

BOD and aesthetic related data is lacking below Granby with BOD and Bac-T lacking at Glenwood Springs. Data fails to pinpoint the impact of major tributaries.

Excellent quality is indicated along this segment in both periods. Rating is now excellent, down from 8 to 2 respectively, in the 1st and 2nd periods. Improvement was noted at Hot Sulphur Springs and Newcastle due to elimination of Bac-T violations and some reduction in D.O. violations. D.O. violations were also reduced at Dotsero. This segment has ample phosphorous but remains nitrogen short throughout. Some manganese violations were noted at Glenwood Springs in the 2nd period. Salinity violations are first observed at Newcastle and occur in nearly 100% of the observations there. Three severe pH events were noted at Hot Sulphur Springs. One pH event was noted at Glenwood Springs. Several zinc events were noted at Dotsero and frequent unionized ammonia violations occurred at Newcastle. No salinity, temperature or PHS events were noted on this segment except for Newcastle where numerous severe salinities were noted. There is a significant flow increase between Hot Sulphur Springs and Dotsero. This segment should meet 1983 goals although high pH at Hot Sulphur Springs and zinc excesses at Dotsero cloud this persumption. A group-by-group violations analysis is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	5.6	1.0
II. Bac-T	11.4	0
IIIa. Nitrogen	5.6	1.0
IIIb. Phosphorous	40.0	46.2
IV. Phys./Aesth.	3.7	5.6

Salinity data is lacking and there is no BOD or Bac-T data at the Utah border. No data is available from Cameo to Fruita - a segment which includes several potentially significant dischargers and irrigation return flows.

Significant Bac-T improvement is indicated by a 14-point drop from 24 to 10 in the index. Improvement was noted at Fruita and Loma. A significant reduction in nitrogen violations was also noted at Cameo. Salinity excesses were noted from Cameo to the border in both periods. Nitrogen and phosphorous rich conditions originate at Fruita and persist to the Utah border.

Severe events highlight zinc excesses and numerous salinity events along the segment. Isolated unionized ammonia events were also noted. Several mercury events were noted at Fruita in the 1st period. There were no temperature or PHS events along the segment but one pH event was noted at each of the Cameo, Fruita and Loma stations.

This segment could meet 1983 goals, if scattered Bac-T violations are reduced and if salinity and eutrophication potential do not make the lower segment unsuitable for a balanced warm water fishery. Zinc and unionized ammonia events as well as infrequent but high pH's necessitate guarded optimism. A group-by-group violations summary is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	4.5	0
II. Bac-T	38.6	10.6
IIIa. Nitrogen	64.8	38.3
IIIb. Phosphorous	42.1	50.0
IV. Phys./Aesth.	34.7	30.0

e. Arkansas River - Headwaters to Canon City.

This reach is a major source of irrigation and storage water to the surrounding farmland. Diversions from the Colorado River Basin augment flow. Some out of basin diversions are made to the South Platte River. There are no major industrial or municipal discharges in this reach.

There is no data between Leadville and Salida or between Salida and Canon City. Data is adequate at Leadville, Salida and Canon City for comprehensive analysis.

A significant decline in violations caused the index to drop from 6 to 2 on the segment. Segment improvement is directly related to Bac-T improvement at each station and to a lesser extent D.O. and nitrogen improvement. Phosphorous generally is abundant along the segment but nitrogen is "short". There were no salinity or BOD violations in either period.

Numerous severe zinc events were rated at Leadville and Salida. There were no salinity or PHS events, but two pH and one temperature event were reported. One D.O. event was also noted.

General quality is good to excellent and unlimited use for recreation is probable, however, fish perpetuation and propagation is questionable due to numerous and high zinc violations. This segment should meet 1983 goals. Group-by-group violations analysis shows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	10.6	2.6
II. Bac-T	9.3	1.2
IIIa. Nitrogen	8.2	0
IIIb. Phosphorous	52.2	51.0
IV. Phys./Aesth.	1.0	1.2

f. Arkansas River from Canon City to the (Kansas) border.

The upper reach has one major cement plant on the mainstem, one major mainstem STP, significant irrigation use and return flow, diversion and storage for industrial use, and filling of the Pueblo Reservoir. The middle reach from Pueblo to Las Anamas is affected by one (seasonal) sugar refinery discharge, a steel mill, a railroad yard discharge, three major mainstem STP's, six major (far upstream) tributary STP's, significant irrigation diversion along the entire reach and irrigation return flows. The lower reach is dominated by John Martin Reservoir; which causes near no flow conditions during winter storage, seasonal irrigation diversions and return flows.

There is no station below Fountain Creek to Nepesta and little or no Bac-T data was found at Portland or below the John Martin Reservoir. Overall the segment rating of 13, down from 20, is positively skewed by the excellent quality from Canon City to above Pueblo.

Headwater type quality is now manifest from Canon City to above Pueblo as indicated by a drop from 13 to 3 along this segment. Improved, though still degraded, conditions from Pueblo to the border are shown by an Index drop of 25 and 16 respectively. A signficant decrease in flow between Canon City and Pueblo and again between Nepesta and La Junta is noteworthy. Low flow persists from La Junta to the border.

Improvement in the upper segment is somewhat distorted by the absence of turbidity and scant nitrogen data in the second period. A significant reduction in Bac-T violations was noted. Numerous and high turbidity excesses were noted above Pueblo in the first period. Improvement in the middle reach is due primarily to reduced Bac-T violations. Salinity violations and nitrogen rich conditions in this reach begin at Nepesta. Salinity violations intensify at La Junta. A high eutrophic potential is shown in both periods. The lower reach indicates lessened phosphorous violations below John Martin Reservoir in both periods and lessened Bac-T violations to the Kansas border in the second. Numerous manganese violations were noted below John Martin Reservoir in both periods.

Severe events note some zinc and mercury violations along the segment. Especially severe salinity events were noted below Las Animas and along the segment to the Kansas border. High total ammonia was noted at Las Animas but only one unionized violation resulted. There were no pH or temperature events, however, excesses of radium 226 phs standards were noted at the Kansas border in the first period.

The upper segment should meet 1983 goals even for a cold water fishery, however, the middle and lower segments do not and will not seem able to perpetuate and allow propagation of balanced warm water fishlife. Routine use of the middle and lower segment for year-round recreation is doubtful due to the low flow during the irrigation season and continued, though sporadic fecal coliform violations. A group-by-group violations review illustrates:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	3.2	1.0
II. Bac-T	27.6	13.4
IIIa. Nitrogen	75.6	70.5
IIIb. Phosphorous	54.1	69.1
IV. Phys./Aesth.	30.8	30.9

g. Rio Grande River Headwaters to the (New Mexico) Stateline.

The upper reach is dominated by numerous storage reservoirs. There are transmountain diversions into this segment from the Colorado River Basin. There are significant irrigation diversions and returns above Alamosa. Below Alamosa continued use for irrigation, storage reservoirs on the mainstem and tributaries, as well as groundwater withdrawals and irrigation returns are the predominant influence.

There is little data above Alamosa.

Generally excellent quality is found on this segment as verified by a 5 rating, down from 7. Some improvement in D.O. and Bac-T at Alamosa and Manassa was noted. Phosphorous rich conditions persist from Alamosa to the border, however, nitrogen appears unavailable to permit eutrophic conditions. There were no salinity violations at Alamosa but at Manassa and Lobatos violations have been observed. High manganese has been noted at two headwater stations and at Lobatos.

There were numerous severe zinc events at the headwaters stations with lesser numbers downstream of Alamosa and on the border. Mercury events were noted at Manassa and Lobatos. Recurring temperature events were measured from Alamosa to Lobatos. There were no salinity or PHS events but one pH event was noted at Lobatos.

This segment should meet 1983 goals, although temperature excesses could make this segment marginal for cold water fish propagation. Zinc events in the headwaters and assorted other events along the segment suggest guarded optimism. A group-by-group violations summary is given below:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	8.0	3.8
II.	Bac-T	5.8	2.9
IIIa.	Nitrogen	3.8	0
IIIb.	Phosphorous	88.2	97.7
IV.	Phys./Aesth	4.1	5.1

h. Green River.

Flow and quality are mostly controlled by the Flaming Gorge Reservoir with some irrigation diversions and returns on the mainstem and significant irrigation diversions and returns on the Yampa River.

Although the first period is unrateable due to a lack of ORB data a rating of 4 in the second does not well account for an increase in salinity and nitrogen violations. There is an increase in violations for salinity and nutrients.

There were no severe events in either period.

Although still rated as excellent and expected to meet 1983 goals, close scrutiny of dissolved solids, suspended solids and nutrient related parameters should be maintained. A group-by-group violations analysis is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	0	0
IIIa. Nitrogen	0	44
IIIb. Phosphorous	25	38
IV. Phys./Aesth.	0	8

i. North Platte River.

Headwaters are affected by diversion for irrigation of hay meadows, some transmountain diversion to the South Platte basin, storage reservoirs and two tributary fluorspar mines.

No BOD or Total coliform data was collected at Northgate in either period. Little phosphorous data is available at Northgate.

Overall quality is excellent and the Index shows improvement from 8 to 5. Two D.O. excesses were noted in 1971. Phosphorous is generally abundant at Cowdrey, but nitrogen is "short".

There were only two severe events noted, one for zinc, the other for pH; both at Cowdrey in the first period.

This segment of the North Platte should meet 1983 goals, assuming D.O. violations do not limit fish life. A group-by-group breakdown of violations are as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	19	7
II. Bac-T	4	3
IIIa. Nitrogen	12	0
IIIb. Phosphorous	50	54
IV. Phys./Aesth.	2	3

j. Colorado Lakes - Horsetooth and Carter Reservoirs.

Horsetooth Reservoir, located on the eastern slope near Ft. Collins contains headwaters diverted from the Colorado basin to the Cache La Poudre River, it is subject to seasonal recreation usage. Carter Reservoir is located on the eastern slope near Loveland and contains headwaters diverted from the Colorado basin to the Big Thompson River and is also subject to seasonal recreation.

There is little or no BOD or aesthetic related data for either reservoir.

General quality remains excellent for both lakes, however, a drop in rating from 2 to 4 was highlighted. Increased D.O. violations were noted in the second period at both lakes. Both lakes manifest increasingly phosphorous rich conditions, but remain nitrogen "short". Numerous temperature and pH (low) violations were noted on Horsetooth Reservoir. Also, numerous temperature violations for Carter Reservoir were noted.

Severe events analysis was limited by little or no data for heavy metals and PHS related parameters. There were no salinity events.

Both lakes should meet 1983 goals, however, continued use of Carter Reservoir as a cold water fishery is suspect and some question remains at Horsetooth too, due to temperature and seasonal D.O. violations.

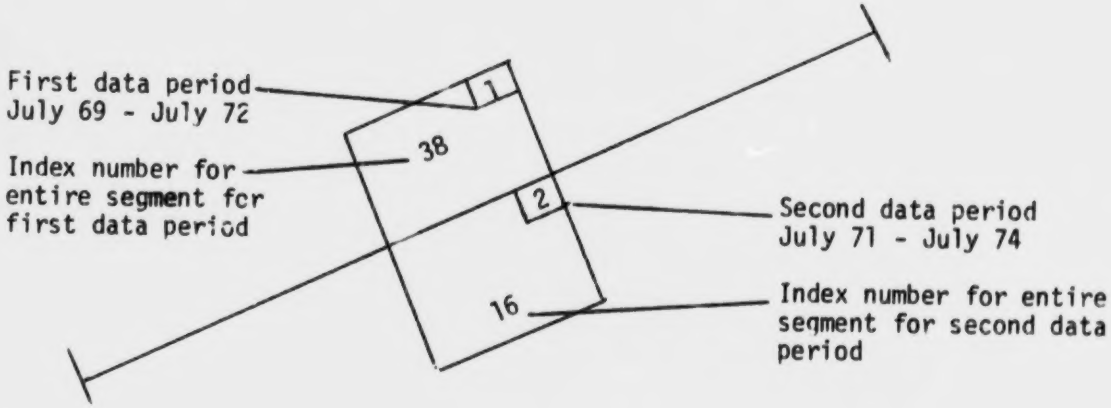
A group-by-group analysis of each is given below:

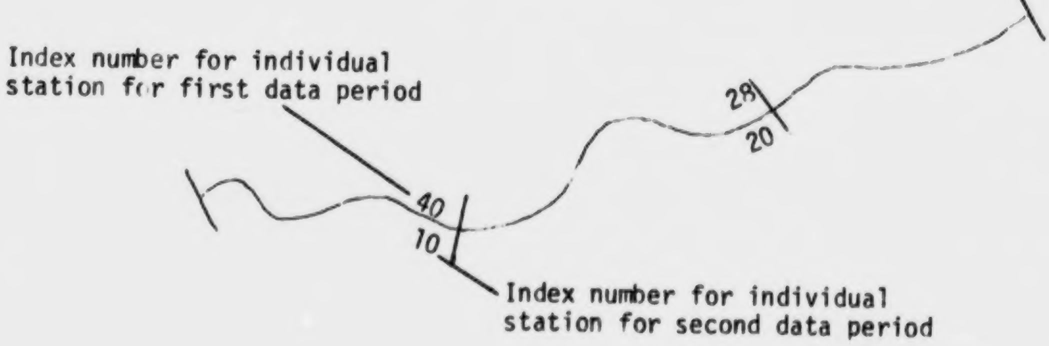
Horsetooth Reservoir Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	4.3	11.3
II. Bac-T	0	0
IIIa. Nitrogen	0	0
IIIb. Phosphorous	61.7	87.9
IV. Phys./Aesth.	0	0

Carter Reservoir Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	11.5
II. Bac-T	0	0
IIIa. Nitrogen	0	0
IIIb. Phosphorous	57.8	82.8
IV. Phys./Aesth.	0	0

Additional Notes for Interpreting

Figure 3 through 8


First data period
July 69 - July 72
1
Index number for entire segment for first data period
38
2
Second data period
July 71 - July 74
16
Index number for entire segment for second data period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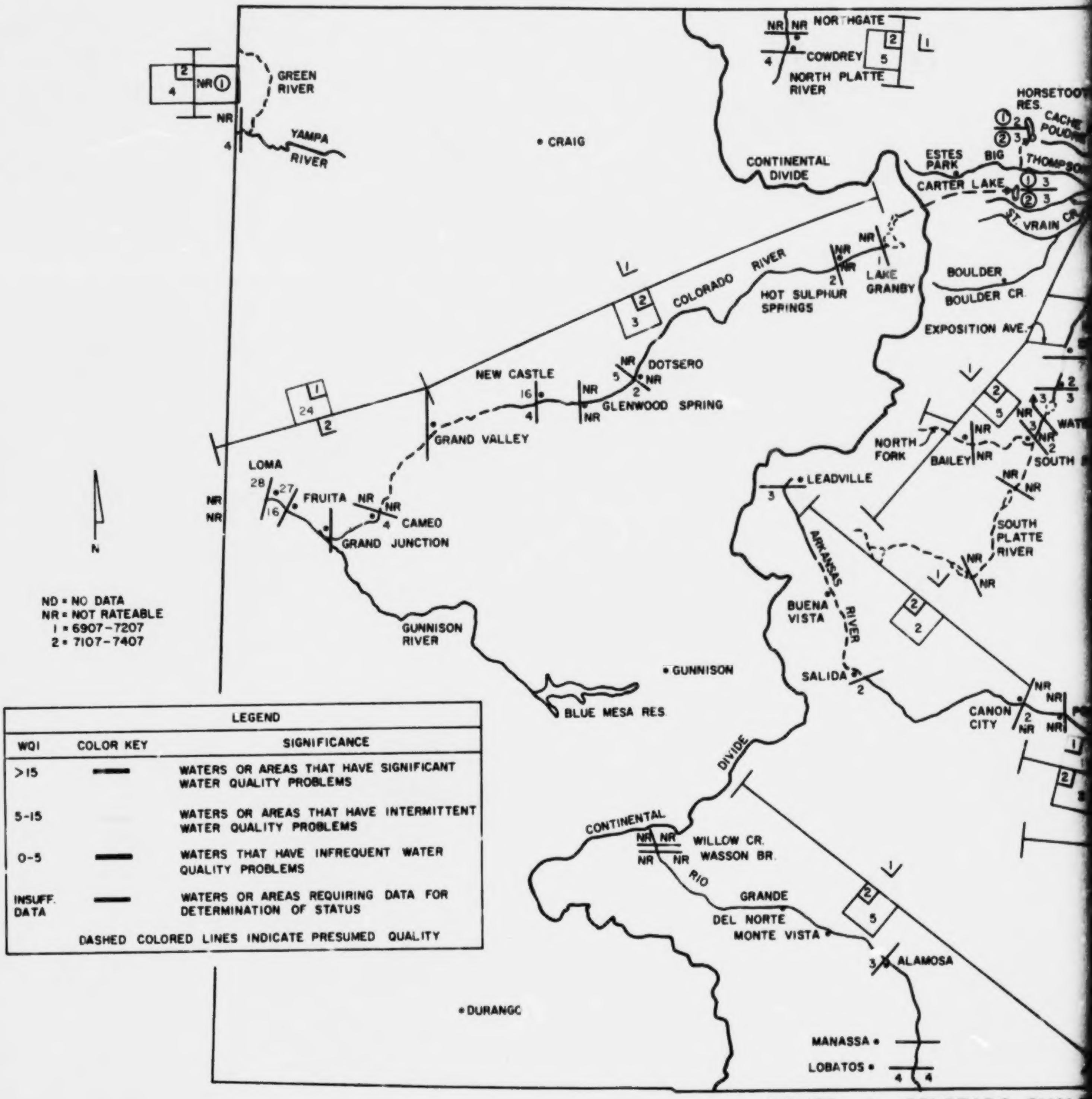
10
28
20
Index number for individual station for second data period


GREEN RIVER
YAMPA RIVER
CRAIG
NORTHGATE
COWDREY
NORTH PLATTE RIVER
HORSETOOTH RES.
CACHE POUDRE
ESTES PARK
BIG THOMPSON
CONTINENTAL DIVIDE
CARTER LAKE
ST. VRAIN CR.
LAKE GRANBY
HOT SULPHUR SPRINGS
COLORADO RIVER
BOULDER
BOULDER CR.
EXPOSITION AVE.
DOTSERO
NEW CASTLE
GLENWOOD SPRING
GRAND VALLEY
LOMA
FRUITA
CAMEO
GRAND JUNCTION
NORTH FORK
BAILEY
SOUTH PLATTE RIVER
LEADVILLE
ARKANSAS RIVER
BUENA VISTA
SALIDA
CANON CITY
GUNNISON RIVER
GUNNISON
BLUE MESA RES.
CONTINENTAL DIVIDE
WILLOW CR.
WASSON BR.
RIO GRANDE
DEL NORTE
MONTE VISTA
ALAMOSA
MANASSA
LOBATOS
DURANGO
N
ND = NO DATA
NR = NOT RATEABLE
1 = 6907-7207
2 = 7107-7407
NR
1
2
3
4
5
16
24
27
28

LEGEND

WQI	COLOR KEY	SIGNIFICANCE
>15	—	WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15		WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5	—	WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
INSUFF. DATA	—	WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS

DASHED COLORED LINES INDICATE PRESUMED QUALITY

FIGURE 3 COLORADO QUAL

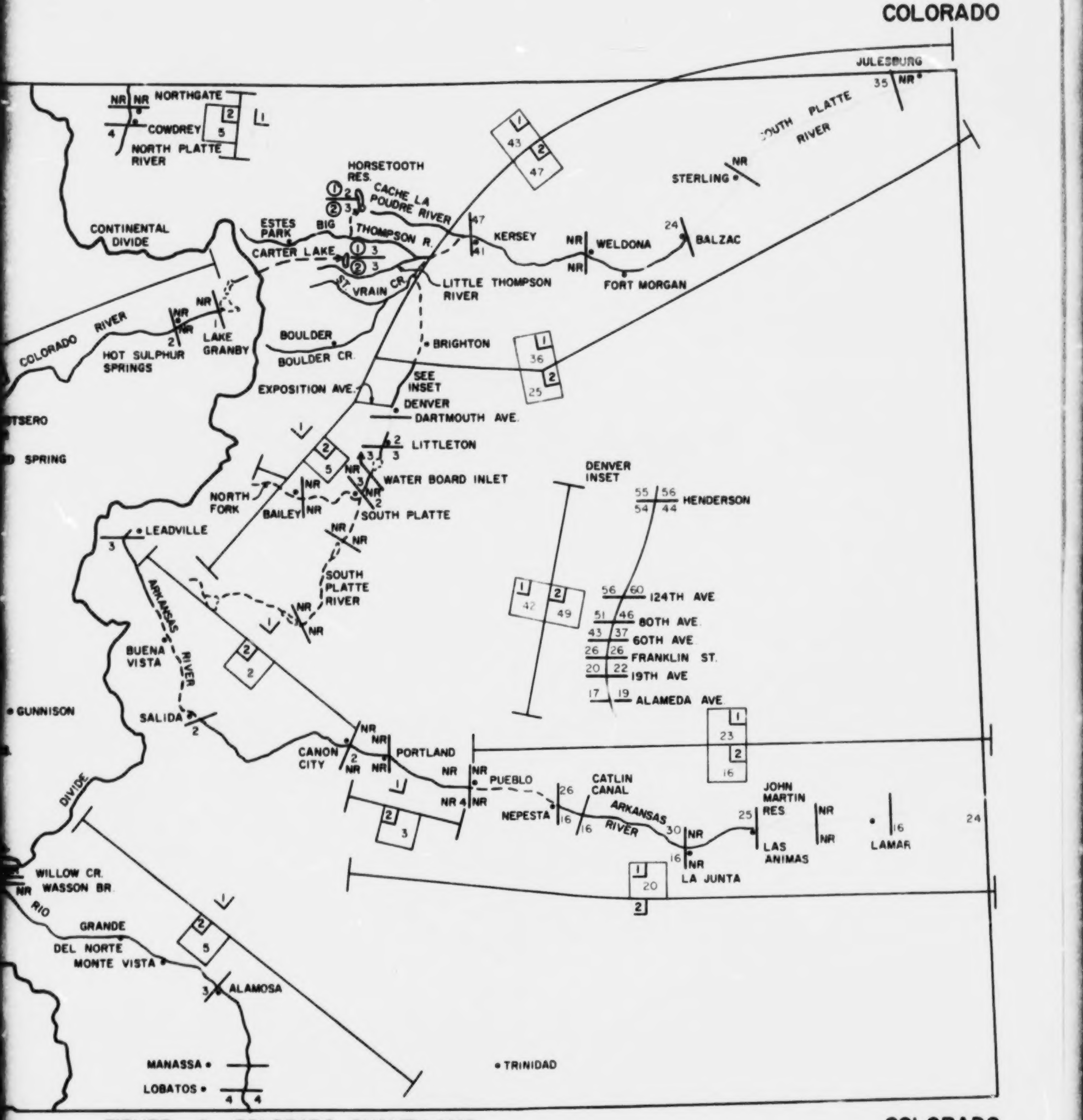

COLORADO
JULESBURG
35 NR
SOUTH PLATTE RIVER
STERLING
NR
NORTHGATE
NR NR
COWDREY
4
2
5
1
NORTH PLATTE RIVER
HORSETOOTH RES.
CACHE LA POUDRE RIVER
① 2
② 3
43
47
BIG THOMPSON R.
ESTES PARK
CONTINENTAL DIVIDE
CARTER LAKE
① 3
② 3
47
41
KERSEY
NR
WELDONA
24
BALZAC
FORT MORGAN
LITTLE THOMPSON RIVER
ST. VRAIN CR.
COLORADO RIVER
HOT SULPHUR SPRINGS
LAKE GRANBY
BOULDER
BOULDER CR.
BRIGHTON
36
25
SEE INSET
EXPOSITION AVE.
DENVER
DARTMOUTH AVE.
LITTLETON
3
WATER BOARD INLET
NORTH FORK
BAILEY
SOUTH PLATTE
SOUTH PLATTE RIVER
LEADVILLE
ARKANSAS RIVER
BUENA VISTA
SALIDA
GUNNISON
DENVER INSET
55 56
54 44
HENDERSON
42
49
56 60 124TH AVE
51 46 80TH AVE.
43 37 60TH AVE.
26 26 FRANKLIN ST.
20 22 19TH AVE
17 19 ALAMEDA AVE.
23
16
CANON CITY
PORTLAND
PUEBLO
NR 4 NR
CATLIN CANAL
NEPESTA
26
16
16
ARKANSAS RIVER
30
JOHN MARTIN RES.
25
LAS ANIMAS
LA JUNTA
LAMAR
24
20
DIVIDE
WILLOW CR.
WASSON BR.
RIO GRANDE
DEL NORTE
MONTE VISTA
ALAMOSA
MANASSA
LOBATOS
4 4
TRINIDAD
TSERO
SPRING

FIGURE 3 COLORADO QUALITY MAP

COLORADO

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2. Montana.

a. Missouri River - Headwaters to Sun River.

There are numerous reservoirs both on the mainstem and tributaries - used mostly for irrigation and hydroelectric power. Abandoned mines and irrigation return impact quality. There are four major manmade lakes, namely, Clark Canyon (on a triburary), Canyon Ferry, Hauser Lake and Holter Lake that affect quality. Located on tributaries are one major STP, one major metal processing industry and one cylinder gas producer.

There is no station from the Canyon Ferry Reservoir to the Sun River. Toston has data in the second period only. Townsend has little or no Bac-T data and generally little data overall. Overall quality appears good to excellent.

Despite being unrateable in the first period a 6 rating was noted in the second. Available data, limited as it is, indicates ample phosphorous and frequent availability of nitrogen. There were no salinity violations but occasional turbidity excesses noted at Toston and Townsend. Bacterial quality appears good although single total coliform violations at Toston and Townsend were noted.

Severe events noted copper, lead and zinc problems at Toston. There was no PHS or salinity events but two marginal pH and one marginal temperature violation were noted.

Heavy metals events and lack of data cloud the determination of whether this segment will meet 1983 goals, although expectations are that it will. A group-by-group violations review is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	50	5.7
IIIa. Nitrogen	25	33.3
IIIb. Phosphorous	0	76.2
IV. Phys./Aesth.	18.2	5.4

b. Missouri River from the Sun River to Rainbow Dam.

Quality is affected by upstream reservoirs, irrigation and industrial use as well as flood control and power dams in this reach, especially Morony Dam. Mainstem impacts include one STP, one major oil refinery, and one large metals processing industry. One major STP is located on a near reach of a tributary.

No data is available in STORET for this segment.

Overall analysis is not directly assessible although major D.O. and coliform impact due to the STP at Great Falls is cited by the State of Montana as a recurring problem.

c. Missouri River from Rainbow Dam to Fort Peck Dam.

Quality is basically a function of upstream irrigation, power-projects and point and non-point sources. The Morony Dam powerplant causes, at times, wide daily flow variations.

There is no BOD, Bac-T and little phosphorous data available at Zortman.

Quality is excellent in this reach as manifest by a 3 and 2 index rating respectively in the first and second periods. Abundant phosphorous is available at Benton.

Mercury severe events are noteworthy at Zortman and Ft. Benton. There were no PHS, salinity, temperature or pH events.

Mercury violations need to be clarified before 1983 goals can be assumed attainable. A group-by-group review of percent violations shows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	0	3.2
IIIa. Nitrogen	0	0
IIIb. Phosphorous	95	94.1
IV. Phys./Aestn.	4.9	1.0

d. Missouri River from Ft. Peck to Milk River.

This short reach is dominated by Fort Peck Reservoir with quality also affected by upstream irrigation.

No BOD, Bac-T or aesthetic-related parameters are monitored. Large quantities of D.O. and conductivity data were taken.

Overall quality is not rateable, however, indications are that this reach has excellent quality. Infrequent phosphorous violations were noted. Unexpected salinity violations were noted.

Occasional but severe salinity events were noted. Two unexplained severe mercury events are noteworthy.

This reach is expected to meet 1983 goals. A group-by-group analyses of percentage violations is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	1.0
II. Bac-T	ND	ND
IIIa. Nitrogen	0	0
IIIb. Phosphorous	35.3	0
IV. Phys./Aesth.	0	1.0

e. Missouri River from the Milk River to the (North Dakota) Stateline.

Quality is largely affected by Fort Peck Reservoir and upstream uses for irrigation, as well as reservoirs on tributaries that feed this reach. One major STP is located far upstream on a tributary.

No D.O., BOD or Bac-T data is taken at Wolf Point. Excellent overall quality is indicated by a 4 and 2 rating respectively in the first and second periods. Phosphorous is generally abundant along the segment. Improvement in turbidity was noteworthy at Culbertson.

Two severe mercury events were noted at Culbertson. There were no other severe events in the PHS, salinity, temperature or pH categories.

Mercury events cloud an unqualified statement that this reach will meet 1983 goals. Group-by-group violations percentages are:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	0
II.	Bac-T	14.3	0
IIIa.	Nitrogen	0	2.5
IIIb.	Phosphorous	63.2	35
IV.	Phys./Aesth.	3.6	0

f. Bighorn River - Wyoming border to Williams Coulee (below Hardin).

Quality is affected by numerous upstream reservoirs especially, Bighorn Lake. There are significant irrigation uses upstream in Wyoming and some in Montana too.

There was no D.O., BOD or Bac-T data in the second period at the sole rateable station.

Data in the first period and the general nature of this watercourse suggest that salinity is the prime problem. Phosphorous is often available although nitrogen is seldom found to be a violation.

No severe events were noted although data for PHS and toxic events were unavailable. State of Montana analysis indicates sediment as a problem.

Data is lacking to gauge trends or to assess whether this segment will meet 1983 goals. Violations percentages grouped by Index arrangement show:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. OPB	0	ND
II. Bac-T	0	ND
IIIa. Nitrogen	1.4	5
IIIb. Phosphorous	44.1	21.3
IV. Phys./Aesth.	23.6	17.7

g. Bighorn River - Williams Coulee to the Yellowstone River.

Quality is largely a function of upstream irrigation uses and upstream reservoirs and land use practices.

Data is generally in short supply with little or no pH or toxic data. Little or no D.O., BOD or Bac-T data was available at Bighorn.

A current rating of 6, down from 11, indicates improved Bac-T conditions at Hardin. Generally abundant in phosphorous the Hardin station is nitrogen short, whereas, data at Bighorn indicates neither nitrogen or phosphorous problems. Salinity is a frequent violation along the segment. Occasional coliform violations were noted at Hardin.

Marginal temperature events were noted at Hardin and Bighorn and a single 9.1 pH event at Bighorn was also detected.

Overall quality is very good to excellent although additional data for PHS and toxic constituents should be available before an unqualified judgment is rendered that this reach will meet 1983 goals.

A group-by-group violations analyses by percentage is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	27.3	10
IIIa. Nitrogen	4.0	0
IIIb. Phosphorous	40.5	36.1
IV. Phys./Aesth.	37.3	28.2

g. Yellowstone River - Yellowstone Park to the Laurel WTP.

Quality is primarily affected by significant irrigation diversions on the mainstem and to some extent by reservoir and irrigation diversion on two tributaries.

There is no D.O., BOD or Bac-T data at Livingstone and no station between Livingstone and the Laurel WTP.

No significant problems are defined. Phosphorous is abundant at Livingstone and at Corwin Springs.

Occasional, though marginal, pH events were noted at Livingstone and Corwin Springs. One severe event for mercury was also noted.

1983 goals have and should be met along this segment. This assessment is made optimistic by arsenic violations stated by the State of Montana near the confluence of the Gardiner River.

A group-by-group review of percentage violations is as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	0
II.	Bac-T	5	0
IIIa.	Nitrogen	1.2	3.2
IIIb.	Phosphorous	86.8	87.9
IV.	Phys./Aesth.	1.5	1.0

h. Yellowstone River from Laurel WTP to the Billings WTP.

Quality is affected by irrigation diversion, mostly far upstream, on the mainstem and tributaries. One major oil refinery and one significant STP is located on the mainstem along this short segment.

No total coliform data was collected in the second period.

Excellent quality is reflected in ratings of 5 and 3 respectively in the two trend periods evaluated. Phosphorous is generally abundant. One fecal coliform violation was noted in each of the first and second periods.

Only two marginal mercury events were noted.

This segment should meet 1983 goals, however, coliform violations and State of Montana observations of oil and grease cloud this assumption.

Grouped percentage violations summaries for Index data indicate:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	18.2	9
IIIa. Nitrogen	0	0
IIIb. Phosphorous	75.8	80
IV. Phys./Aesth.	2.7	0

i. Yellowstone River from Billings WTP to the (North Dakota) Stateline.

Mainstem quality at and below Billings is affected by two major oil refinery discharges, one seasonal sugar refinery effluent, one power plant discharge and one major STP. Quality downstream of Billings is affected by irrigation diversions on the mainstem, and reservoirs and irrigation diversions as well as other non-point sources along the tributaries, especially the Bighorn and Powder Rivers. Quality near Sidney is affected by one seasonal sugar refinery effluent and one significant STP.

There were no D.O., BOD or Bac-T data at Billings. No station pinpoints the impact of the Bighorn and Powder Rivers. Little D.O., BOD or Bac-T data is available at Miles City.

Marginal quality is indicated by an 8 rating in both periods. Bac-T violations are on the wane but these improvements have been offset by increased nitrogen violations. Phosphorous is generally available along the segment, although a peak in phosphorous and nitrogen is noted at Huntley. Numerous turbidity violations were noted from huntley to Sidney. Frequent coliform violations were found at Huntley. Salinity violations begin at Miles City and were frequent at Sidney.

Severe copper, lead and zinc events were noted at Huntley and one each copper and lead event was noted at Miles City. Dissolved alpha radiation excesses were also noted at Billings.

Heavy metal events underscore the concern that this segment may not meet 1983 goals. A group-by-group summary of percentage Index violations shows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	0
II.	Bac-T	28.6	9.2
IIIa.	Nitrogen	1.9	20.2
IIIb.	Phosphorous	51.2	50.4
IV.	Phys./Aesth.	18.1	14.5

j. Clark Fork River - Warm Springs Creek to Cottonwood Creek.

Headwaters quality is affected by past and present mining activities, impoundments on tributaries for general mining uses. One major copper refining industry is located on a near tributary, and one major STP and one major copper mine are located on an upstream reach of a tributary.

Some decline from 9 to 13 was noted from the first to the second period at the sole rateable station. On this short reach phosphorous is abundant but nitrogen is short. Salinity is a consistent violation. Scattered violations of total coliform and fluoride were also observed.

Severe events are noteworthy for zinc, and to lesser extent for copper and mercury. Numerous severe events were noted, however, no PHS or pH violations were observed.

This reach continues to be of marginal quality for man related uses and is doubtful as a viable fishery. It is questionable if this reach will meet 1983 goals. A group-by-group violations summary as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	15	18.2
IIIa. Nitrogen	0	9
IIIb. Phosphorous	100	90
IV. Phys./Aesth.	53.3	54

k. Clark Fork River from Cottonwood Creek to the Little Blackfoot River.

Quality is affected by past and present upstream mining activities and irrigation diversions on the mainstem and tributaries.

There is no data on this segment in the second period.

No trend is assessable due to the lack of data. A 16 rating in the first period suggests poor quality. Data available in the first period only highlights abundant phosphorous and generally available nitrogen. Frequent salinity and total and fecal coliform excesses were also observed. Managanese is noteworthy as a persistent problem.

Severe events for copper, zinc and aluminum events, as well as marginal mercury and cadmium events, were noted in the first period. One selenium PHS event was detected. No pH violations were observed (one isolated temperature violation was noted). Low D.O. due to eutrophic conditions was cited by the State of Montana along this reach.

Numerous severe events and marginal to poor quality in the first period suggest questionable attainment of 1983 goals. A summary of percentage violations is as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	ND
II.	Bac-T	31	ND
IIIa.	Nitrogen	29.2	ND
IIIb.	Phosphorous	91.3	ND
IV.	Phys./Aesth.	41.8	ND

1. Clark Fork River from the Little Blackfoot River to the Idaho Border.

Quality is affected by past and present upstream mining activities, numerous impoundments on tributaries especially Flathead Lake and Hungry Horse Reservoir and irrigation along the segment. One major STP and one major paper-pulp mill are located at Missoula. Input of the Flathead River, the Noxon Reservoir and Cabinet George Dam dominate the lower segment.

Thompson Falls is the only rateable station in the second period. No station data was available below Missoula.

Improvement indicated by an index change from 4 to 2 is largely a function of decreased data in the upper reach. First period information highlights abundant phosphorous but a shortage of nitrogen along the segment. Occasional total and fecal coliform violations are noted above Missoula and near Alberton. No salinity excesses were identified, however, manganese violations above Missoula and turbidity problems at Thompson Falls were highlighted.

Severe events for zinc, copper, aluminum, and mercury were noted along this segment. Two PHS events for selenium were also observed. Scattered, though marginal, temperature events were measured at Thompson Falls. Supersaturated gases below the Noxon Rapids and Cabinet George Dams were indicated as a limiting factor by the State of Montana in this reach.

This reach is expected to meet 1983 goals if heavy metals from upstream mining activities and coliform in the middle reach are controlled. A group-by-group violations analysis is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	6.0	0
IIIa. Nitrogen	0	0
IIIb. Phosphorous	80.4	72.7
IV. Phys./Aesth.	3.7	1.0

m. Powder River - Wyoming Border to the Yellowstone River.

Quality is affected by diversions for irrigation, storage reservoirs in Wyoming and non-point sources along the segment.

No total coliform data was available at Moorhead in the second period. No good assessment is possible below Moorhead and the actual quality at the Yellowstone confluence is unknown although it is suspected to be degraded.

Absence of total coliform data in the second period is important since 50% violations of this parameter was indicated in the first period. Suggested improvement shown by an Index decline from 18 to 9 is largely a function of the absence of this data. Phosphorous is abundant along the segment but nitrogen is mostly short. Salinity, violations were noted at Moorhead.

Scattered severe events across the period of record at Moorhead note copper, mercury, zinc, and salinity excesses and a single PHS violation for selenium.

Marginal quality is indicated at the single station on this reach. In the absence of total coliform violations it is probable that this segment will meet 1983 goals although full usefulness may be seriously impaired by high salinity. A group-by-group violations analysis is as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	2	4
II.	Bac-T	30	0
IIIa.	Nitrogen	18	14
IIIb.	Phosphorous	63	86
IV.	Phys./Aesth.	56	44

n. Montana Lakes - Flathead and Koocanusa Lakes.

Flathead Lake is a natural lake located near Kalispell which collects much of the runoff from the Glacier National Park and the Flathead Range. It is subject to seasonal tourism and is also used for power production and irrigation. Koocanusa Lake is a recently built reservoir damned near Libby which backs up the Kootenai River into Canada. It is subject to some seasonal tourism and is also used for power production and some irrigation.

There is no data on Flathead Lake in the second period nor on Koocanusa Lake in the first period. Little PHS or toxic data was found for Koocanusa Lake.

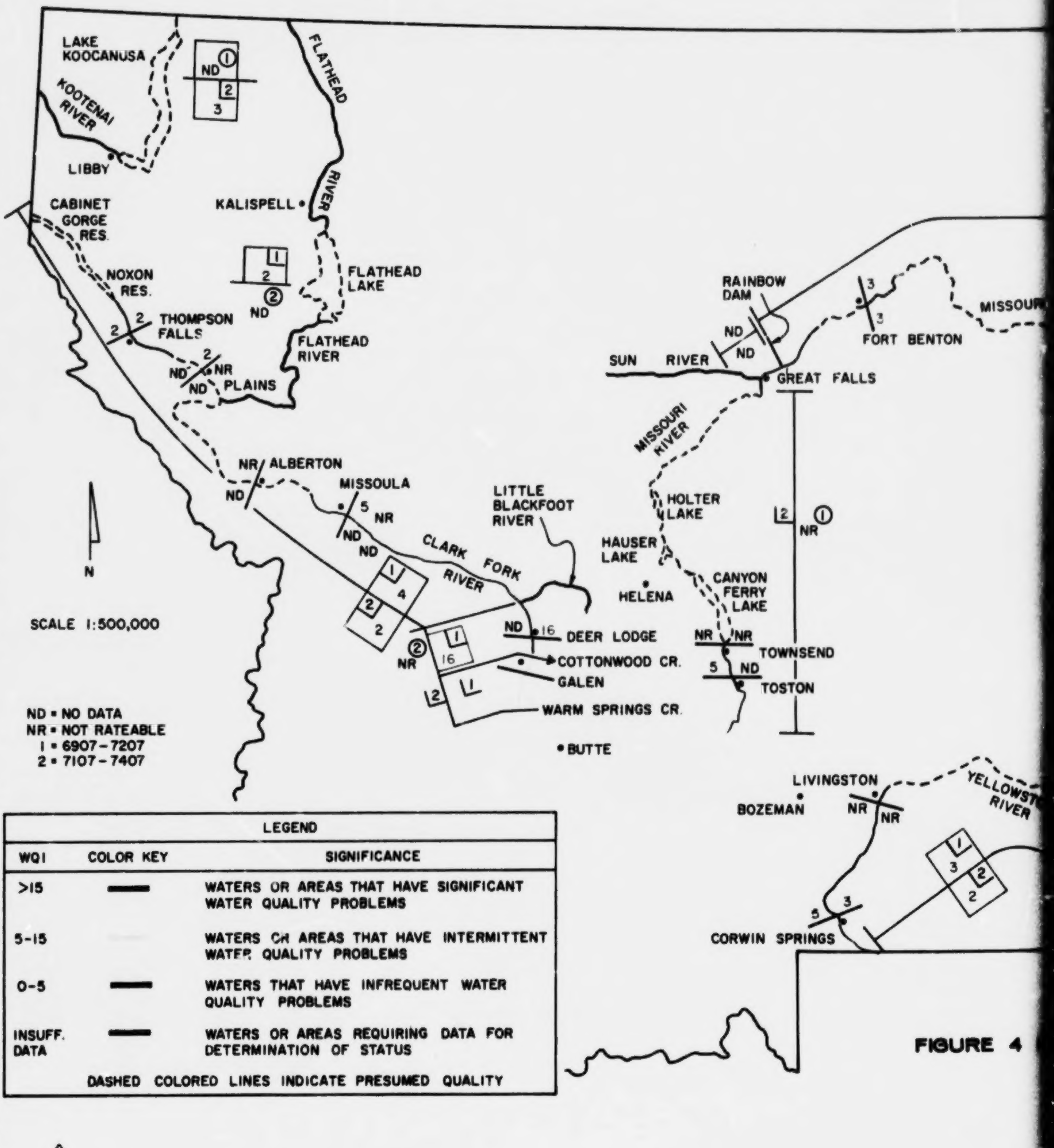
Excellent quality is reflected in a first period rating of 2 for Flathead Lake and a second period rating of 3 for Koocanusa Lake. Flathead Lake shows phosphorous available in one of every three samples. Phosphorous is generally abundant in Koocanusa Lake. Nitrogen seems short in both lakes. Koocanusa Lake has shown manganese excesses at all three sampling locations. Algal blooms have been observed in the Canadian and upper U.S. section of Koocanusa Lake.

In Flathead Lake several temperature events were noted and one mercury and one zinc events were also observed. Two PHS events for selenium were detected. Several marginal temperature excesses were also noted on Koocanusa Lake and one isolated salinity violation was also observed.

Both lakes should meet 1983 goals although heavy metals and PHS events along with some temperature abnormalities at Flathead are cause for concern. Nutrient controls may be required on Koocanusa Lake if 1983 goals are to be met. Grouped violations summaries for both lakes are given below:

Flathead Lake Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	ND
II.	Bac-T	-	ND
IIIa.	Nitrogen	0	ND
IIIb.	Phosphorous	30	ND
IV.	Phys./Aesth.	0	ND

Koocanusa Lake Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	ND	0
II.	Bac-T	ND	0
IIIa.	Nitrogen	ND	4
IIIb.	Phospnorous	ND	77
IV.	Phys./Aesth.	ND	3


LAKE KOOCANUSA
KOOTENAI RIVER
LIBBY
FLATHEAD RIVER
KALISPELL
CABINET GORGE RES.
NOXON RES.
FLATHEAD LAKE
THOMPSON FALLS
FLATHEAD RIVER
PLAINS
NR ALBERTON
ND
MISSOULA
5 NR
ND
ND
CLARK FORK RIVER
LITTLE BLACKFOOT RIVER
DEER LODGE
16
COTTONWOOD CR.
GALEN
WARM SPRINGS CR.
BUTTE
HELENA
HAUSER LAKE
HOLTER LAKE
MISSOURI RIVER
CANYON FERRY LAKE
TOWNSEND
TOSTON
NR
5
SUN RIVER
GREAT FALLS
RAINBOW DAM
ND
FORT BENTON
3
MISSOUR
LIVINGSTON
BOZEMAN
NR
YELLOWST RIVER
CORWIN SPRINGS
5
3
N
SCALE 1:500,000

ND = NO DATA
NR = NOT RATEABLE
1 = 6907-7207
2 = 7107-7407

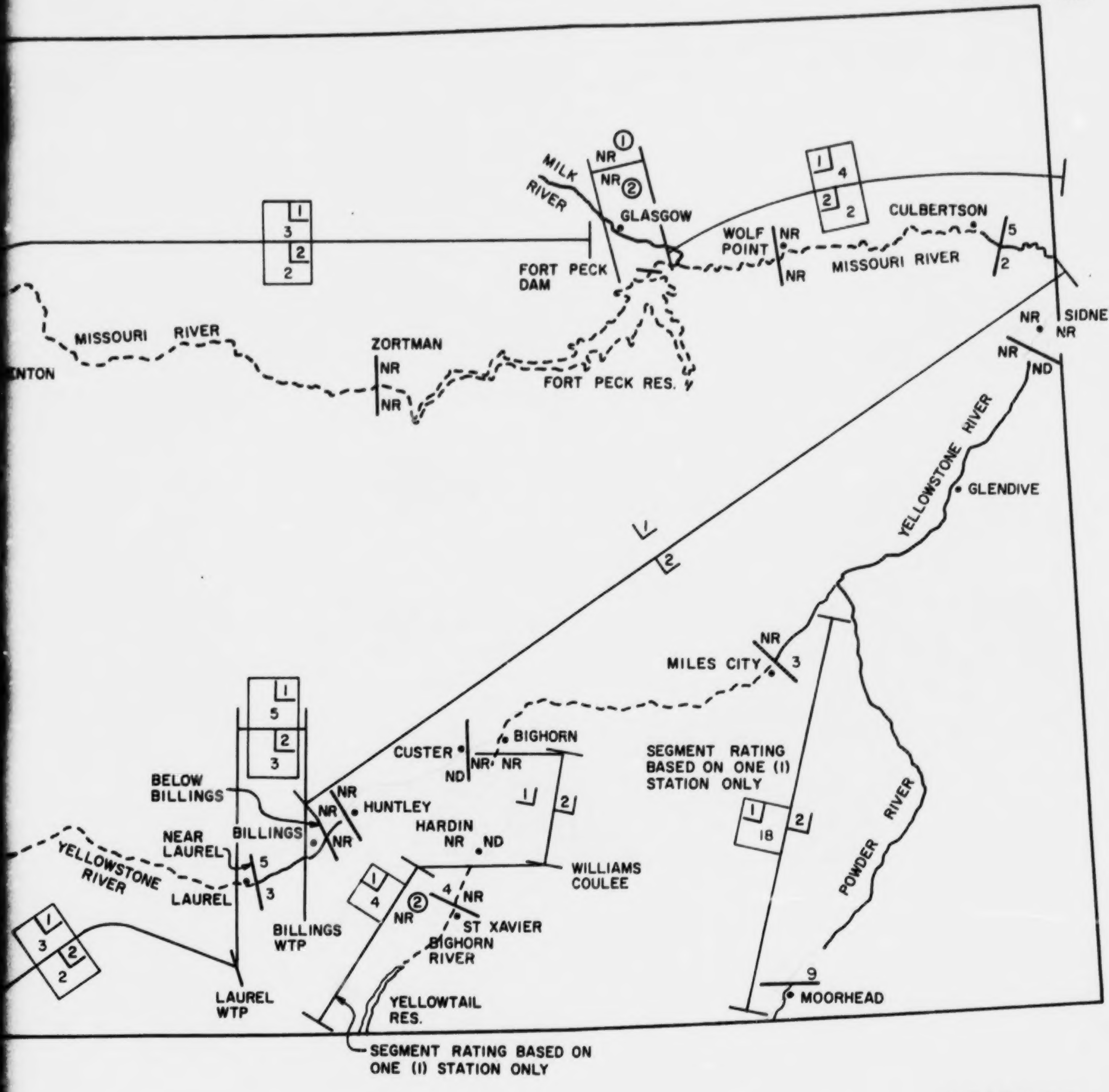
LEGEND

WQI	COLOR KEY	SIGNIFICANCE
>15	▬	WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15	▬	WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5	▬	WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
INSUFF. DATA	▬	WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS

DASHED COLORED LINES INDICATE PRESUMED QUALITY

FIGURE 4

A


MILK RIVER
GLASGOW
FORT PECK DAM
WOLF POINT
MISSOURI RIVER
CULBERTSON
SIDNEY
ZORTMAN
FORT PECK RES.
NTON
YELLOWSTONE RIVER
GLENDIVE
MILES CITY
POWDER RIVER
MOORHEAD
CUSTER
BIGHORN
HUNTLEY
HARDIN
BELOW BILLINGS
BILLINGS
NEAR LAUREL
LAUREL
BILLINGS WTP
LAUREL WTP
WILLIAMS COULEE
ST XAVIER
BIGHORN RIVER
YELLOWTAIL RES.
SEGMENT RATING BASED ON ONE (I) STATION ONLY
SEGMENT RATING BASED ON ONE (I) STATION ONLY
NR
ND
1
2
3
4
5
9
18

IGURE 4 MONTANA QUALITY MAP

★ U.S. Government Printing Office: 1976-682-836

3. North Dakota.

a. Missouri River.

Quality is dominated by Lake Sakakawea (Garrison Dam). Mainstem dischargers include three power plants, and two major STP's. Near reaches of tributaries are impacted by one oil refinery and one power plant (seasonal) discharge. Plans and construction are well underway for the Garrison Diversion Project which will divert Missouri River water to the Souris and Red River Basins and ultimately into Canada.

There is no BOD or Bac-T data except at Bismarck. The Washburn station has been discontinued.

Quality is excellent along this reach as indicated by a 1 and 2 rating respectively. Abundant phosphorous is available at Williston and below Garrison Dam. The entire reach is nitrogen short. Isolated salinity violations were noted at Williston and below Garrison Dam. Numerous turbidity violations were noted at Williston and Bismarck in the first period only. Frequent color violations were observed at Bismarck in the first period too.

Unexplained severe events for mercury were highlighted at Newtown and the Garrison Dam. Scattered events were noted at Williston for copper, lead and zinc. Unexplained lead and zinc events were also observed at Garrison Dam. There were no salinity or PHS events.

This reach should meet 1983 goals, although the impact of heavy metals on this reach should be identified.

A group-by-group breakdown of violations percentages shows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	0	1.6
IIIa. Nitrogen	0	3.7
IIIb. Phosphorous	45.3	39.6
IV. Phys./Aesth.	1.3	0.2

b. Souris River.

Upstream quality is dominated by Lake Darling on the mainstem and smaller reservoirs on the tributaries, especially along the Des Lac and Wintering Rivers. There is some overall diversion for irrigation and municipal supplies. One major STP is located on the mainstem and there is also one major STP on a nearby tributary. In-basin diversions are planned as part of the Garrison Diversion Project.

The data base is good, however, some stations monitor phosphorous and not nitrogen.

Continued water quality problems are manifest on the U.S. segment of the Souris River below Lake Darling as shown by an 18 and 19 rating respectively. Numerous D.O. violations were observed. Frequent total and fecal coliform violations were noted at Minot. Phosphorous is abundant but nitrogen is short along this reach. Salinity is a persistent segment violation intensifying at Verendrye and remaining so to the border. Color violations are noted along the reach. Frequent manganese violations were detected at Foxholm and Verendrye.

Severe events were numerous along this reach and among these D.O. and pH were the most noteworthy. Scattered copper, zinc and aluminum events were also noted along the segment. Several ionized ammonia violations were measured at Westhope where one PHS violation for selenium was also observed. Near no flow conditions are frequent along this segment.

This reach is not expected to meet 1983 goals in the absence of flow augmentation and elimination of numerous events that can cause upset to aquatic ecosystems. Percentage violations summaries are as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	6.2	9.1
II.	Bac-T	20.5	17.8
IIIa.	Nitrogen	6.9	5.6
IIIb.	Phosphorous	89.0	91.7
IV.	Phys./Aesth.	35.3	38.7

c. Red River of the North.

Quality is dominated by reservoirs at the headwaters and on the tributaries, most noteably on the Sheyenne and Park Rivers. The watercourse changes its name from the Bois de Sioux to the Red River of the North below Ottertail Creek at Wahpeton. There are extensive diversions along the tributaries for irrigation use. Diversions and returns along the mainstem are made for water supplies and two major power plants, as well as for general agricultural use. Four sugar refinery discharges (seasonal) are located on/or near the mainstem and one major refinery discharge (seasonal) is on a tributary. Three major STP's are on the mainstem and one is located on a Minnesota tributary. In-basin diversions are planned as part of the Garrison Diversion Project.

The data base is excellent despite the fact that several stations monitor phosphorous and not nitrogen.

Improvements in dissolved oxygen and other STP related parameters are largely responsible for improved quality as shown by a rating improvement from 18 to 12. Less frequent total and fecal coliform violations are noted along the segment in the second period. Phosphorous is available nearly 100% of the time. Nitrogen is short below Fargo but generally available from Fargo to Canada. Occasional salinity violations are noted, peaking at Grand Forks and remaining high at Drayton and Pembina. Frequent turbidity and color violations are noted along the segment.

Severe events are extensive along the segment. Polychlorinated biphenyl (PCB) events were noted at Oslo and Pembina. Zinc, mercury and lead events were noted along the segment. Frequent, though marginal, violations for copper and cadmium were also noted. PHS drinking water violations for cadmium and barium were noted at Grand Forks and Oslo and Grand Forks and Drayton respectively. Mercury, a proposed standard, was detected at Pembina and Fargo at/and near the 2.0 μg/l suggested maximum. Many pH events, mostly high, have been measured with some in excess of 9.0 at Fargo and Emerson, Canada. Scattered events for aluminum, unionized ammonia and cyanide were observed at Wahpeton and Fargo. Several known fish kills have occurred below Fargo. One major spill from a no-discharge sugar mill presumably accounted for another below Hillsboro, North Dakota.

Continued severe events for numerous heavy metals and assorted other parameters makes it questionable that this watercourse will meet 1983 goals. Summary percentage violations data shows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	4.2	1.0
II.	Bac-T	46.9	38.2
IIIa.	Nitrogen	16.8	17.0
IIIb.	Phosphorous	96.0	95.7
IV.	Phys./Aesth.	14.3	13.0

d. James River.

Quality is affected by three large reservoirs above Jamestown and diversions for agricultural and municipal uses. One major STP is located on the mainstem.

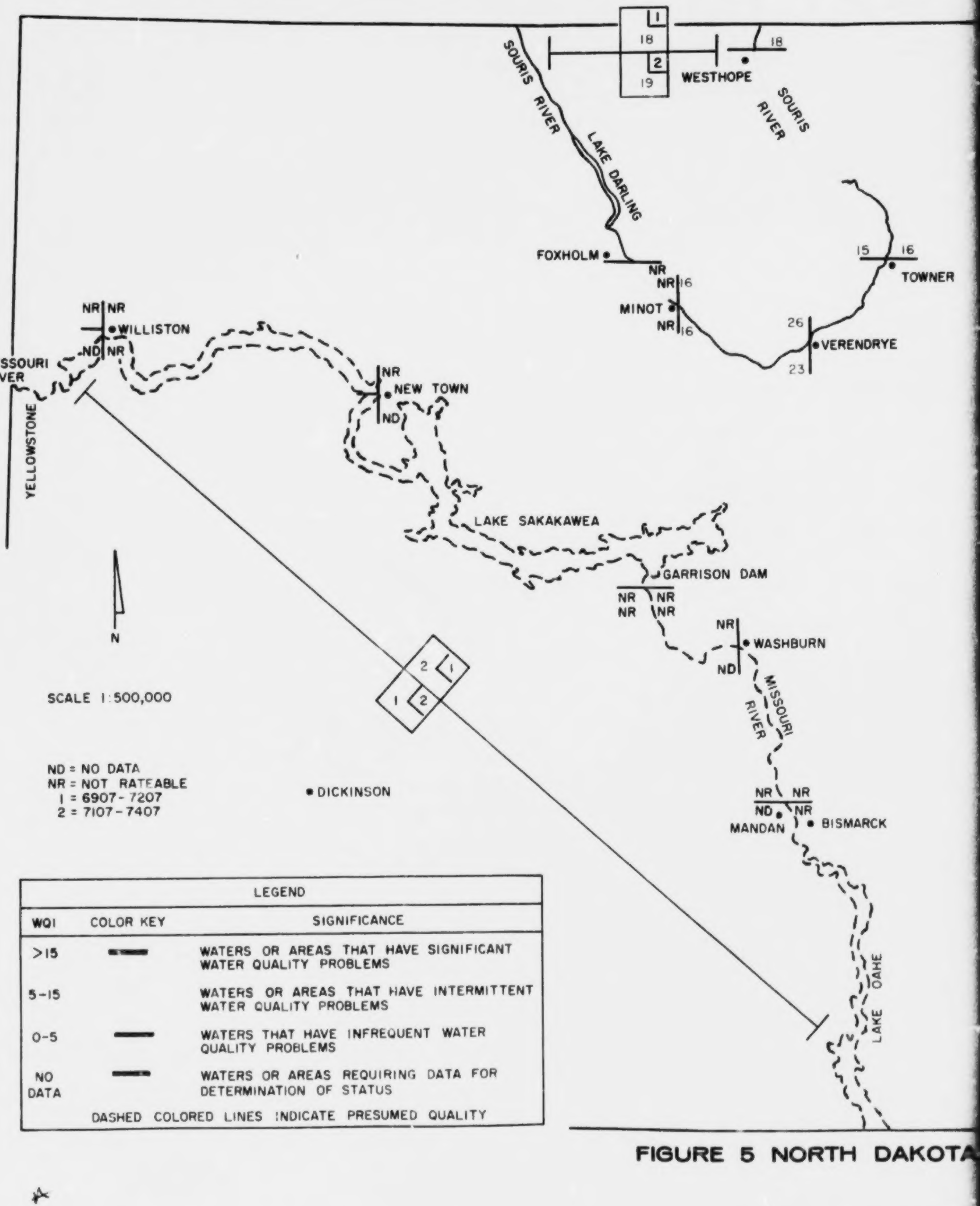
No nitrogen or aesthetic related data is available at Edwards or Jamestown in the second period.

A decline in quality from 18 to 23 attributable primarily to Bac-T violations is indicated by Index analysis. Oxygen related standards are violated at Edwards and Oakes in both periods. Numerous total, and to a lesser extent fecal coliform violations were noted along the segment below Jamestown. Phosphorous is abundant 100% of the time along the segment. Frequent salinity excesses, intensifying at and below Jamestown to Oakes, were monitored along this segment. Turbidity was a frequent violation, when measured, at La Moure and Oakes.

Numerous high pH events were observed along the segment, some in excess of 9.0. Mercury events and, scattered but infrequent events for copper, unionized ammonia and aluminum were also observed. One PHS event for selenium was detected at La Moure. There were no temperature events. Near no flow conditions are frequent at Jamestown.

Coupled with numerous severe events and low flow this reach of the James River is not expected to meet 1983 goals without flow augmentation. Grouped summaries for percentage violations are as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	3.5	4.9
II. Bac-T	26.6	37.4
IIIa. Nitrogen	15.0	12.1
IIIb. Phosphorous	98.7	100.0
IV. Phys./Aesth.	40.6	45.0



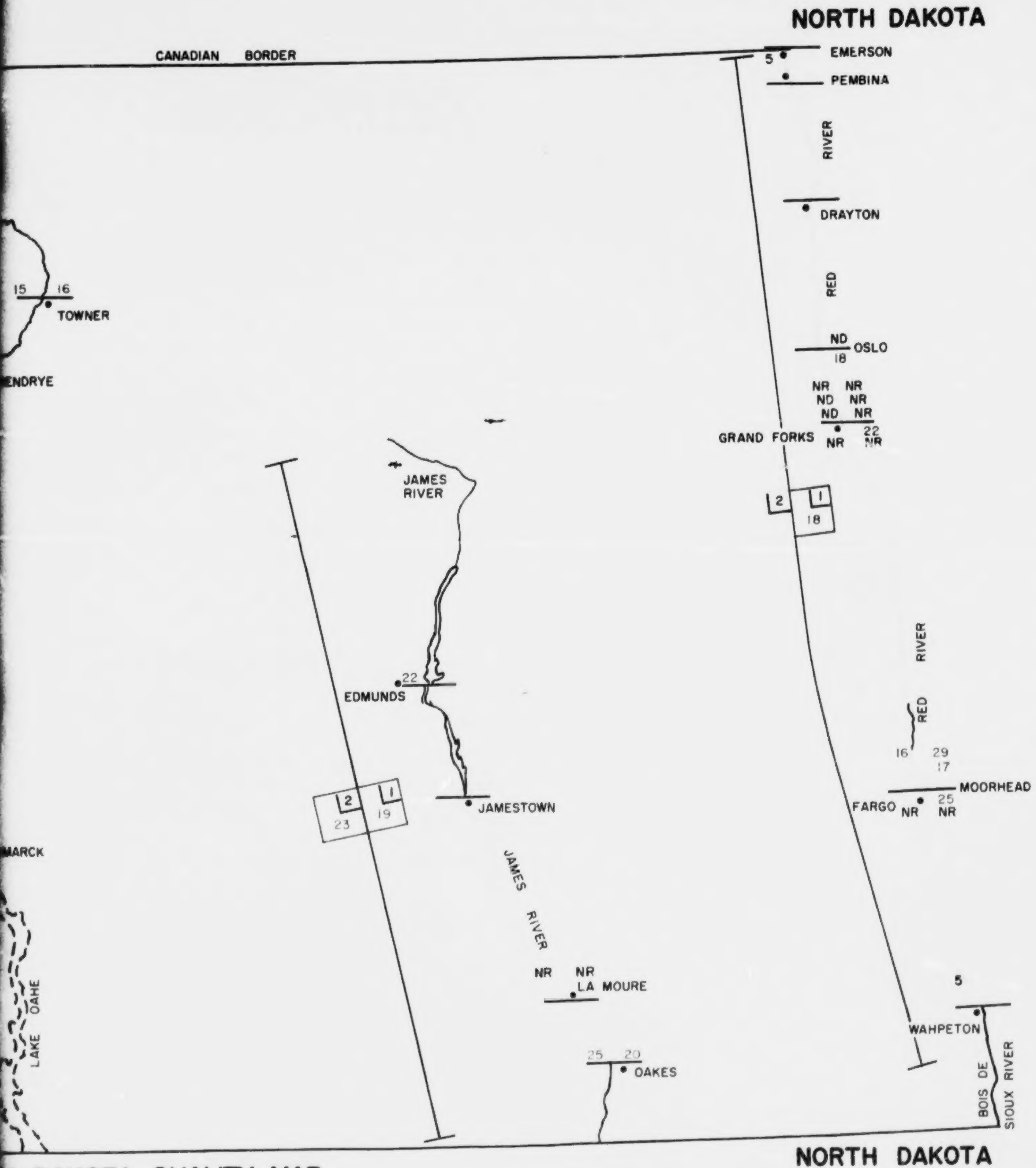
SOURIS RIVER
LAKE DARLING
18
19
1
2
18
WESTHOPE
SOURIS RIVER
FOXHOLM
NR
NR 16
MINOT
NR 16
15 16
TOWNER
26
VERENDRYE
23
NR NR
WILLISTON
ND NR
MISSOURI RIVER
YELLOWSTONE
NR
NEW TOWN
ND
LAKE SAKAKAWEA
GARRISON DAM
NR NR
NR NR
NR
WASHBURN
ND
MISSOURI RIVER
N
2 1
1 2
SCALE 1:500,000
ND = NO DATA
NR = NOT RATEABLE
1 = 6907-7207
2 = 7107-7407
DICKINSON
NR NR
ND NR
MANDAN
BISMARCK
LAKE OAHE

LEGEND

WQI	COLOR KEY	SIGNIFICANCE
>15	▬	WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15		WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5	▬	WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
NO DATA	▬	WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS

DASHED COLORED LINES INDICATE PRESUMED QUALITY

FIGURE 5 NORTH DAKOTA


NORTH DAKOTA
CANADIAN BORDER
5
EMERSON
PEMBINA
RIVER
DRAYTON
RED
ND
18
OSLO
NR NR
ND NR
ND NR
GRAND FORKS
NR
22
NR
2
1
18
15
16
TOWNER
ENDRYE
JAMES RIVER
22
EDMUNDS
2
1
23
19
JAMESTOWN
MARCK
JAMES RIVER
NR NR
LA MOURE
25 20
OAKES
LAKE OAHE
RIVER
RED
16
29
17
MOORHEAD
FARGO
NR
25
NR
5
WAHPETON
BOIS DE SIOUX RIVER
NORTH DAKOTA

H DAKOTA QUALITY MAP

7-48

1 3

☆ U.S. Government Printing Office: 1976-682-836

4. South Dakota.

a. Missouri River from the North Dakota border to Big Bend Dam.

Quality is dominated by Oahe Lake. Some irrigation diversions and returns on tributaries have localized impact. One major STP is located on the mainstem. One major source of heavy metals tailings and one major STP are located on far upstream tributaries.

No BOD, Bac-T or aesthetic related data is available below Oahe Dam, however, a large quantity of D.O. and salinity data is available.

Although unrateable in the first period some decline from upstream quality is suggested by a rating of 5 in the second period. This decline seems to be due to increased salinity and phosphorous violations. Numerous salinity excesses were observed below Oahe Dam. Phosphorous is generally abundant at Pierre.

Severe events note numerous temperature excesses below Oahe Dam and some marginal temperature excesses at Pierre. Marginal pH events were observed below Oahe Dam and at Pierre. Several mercury events were noted below Oahe Dam. No salinity or PHS events were observed.

This segment is expected to meet 1983 goals, however, mercury violations need explanation. Importantly, the Cheyenne arm of Oahe Reservoir has been closed to commercial fishing because of high mercury in fish flesh.

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	ND	0
IIIa. Nitrogen	0	7.5
IIIb. Phosphorous	24.3	44.2
IV. Phys./Aesth.	28.7	45.8

b. Missouri River from the Big Bend Dam to the Iowa Border.

Quality is dominated by three manmade lakes, specifically Lake Sharp (Big Bend Dam), Lake Francis Case (Ft. Randall Dam) and Lewis and Clark Lake (Gavins Point Dam). Many irrigation and water supply diversions are located on this reach. Several irrigation diversions are located on the main tributary (White River) to Lake Francis Case. There is one major STP on a tributary in this reach. Numerous

STP's and industrial dischargers are located on the James and Big Sioux River tributaries - generally at far upstream locations.

No data is available below the Ft. Randall Dam. Large quantities of D.O. and salinity data are available at the Gavins Point Dam. Little aesthetic related data is available along the segment.

Excellent quality is reflected in a 4 rating in both periods. Phosphorous is abundant at Yankton (although limited below Big Bend Dam). Frequent salinity violations were noted below the Big Bend Dam and the Gavins Point Dam. Occasional salinity violations were monitored along the reach below the Gavins Point Dam with some increase in frequency in the second period.

Numerous severe temperature events were measured below Big Bend Dam with isolated events also noted below the Gavins Point Dam and at the Yankton station. Numerous, though marginal pH events were noted along the reach. Several mercury events were observed below Big Bend Dam.

Temperature and mercury violations make it questionable that this reach will meet 1983 goals regarding unqualified use as a cold water fishery. Grouped violations percentages are as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	0
II.	Bac-T	0	0
IIIa.	Nitrogen	1.8	1.8
IIIb.	Phosphorous	57.6	53.8
IV.	Phys./Aesth.	15.9	27.5

c. Cheyenne River from the Wyoming Border to the Angostura Dam.

Upstream quality is affected by numerous small reservoirs used for stock watering and irrigation.

Edgemont is the only data rich station in this reach. Some improvement is suggested by an Index change from 18 to 14. Frequent fecal coliform violations, abundant phosphorous and intense salinity violations mark the quality of this segment. Numerous chloride excesses and manganese violations were also denoted.

Frequent and often very severe salinity events were noteworthy in both periods. Zinc and copper events were identified as were two PHS events for selenium. Unionized ammonia events and one each event for D.O., cadmium, cyanide and mercury were also highlighted.

Salinity events and assorted events in other categories cast serious doubt regarding the ability of this segment to meet 1983 goals without flow augmentation and removal of heavy metals and other violations.

A group-by-group violations summary is as follows:

Index Group		Percent Violations 69C7 - 7207	Percent Violations 7107 - 7407
I.	ORB	3.5	0
II.	Bac-T	7.1	19.2
IIIa.	Nitrogen	33.3	10.7
IIIb.	Phosphorous	72.7	81.5
IV.	Phys./Aesth.	81.9	67.6

d. Cheyenne River from Angostura Dam to the Fall River.

Quality is a product of upstream agricultural uses and Angostura Reservoir where water is stored for irrigation use. This short segment has no significant point source contributions.

No D.O., BOD or Bac-T data is available at the lone rateable station below Angostura Dam. This segment is unrateable for lack of data but phosphorous is generally abundant and nitrogen is generally unavailable. Salinity is a frequent violations.

Severe events for salinity were observed for 100% of the samples taken. Although little PHS or toxic data was collected one mercury and one aluminum violations were observed. Near no flow conditions are frequent below the dam.

Indications are this segment may meet 1983 goals, nevertheless, additional data for this segment should be collected or otherwise made available. A group-by-group analysis of percentage violations is as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	ND	ND
II.	Bac-T	ND	ND
IIIa.	Nitrogen	12.2	8.8
IIIb.	Phosphorous	79.4	69.4
IV.	Phys./Aesth.	36.2	33.3

e. Cheyenne River from the Fall River to the Missouri River.

Quality is affected by upstream and downstream agriucltural uses and returns on the mainstem and tributaries. Angostura Reservoir as well as reservoirs on the Belle Fourche River and Rapid Creek affect quality. One major STP, a major sand and gravel operation and one cement plant are located on a tributary. One major mining industry is situated in the basin.

No D.O., BOD, or Bac-T data is available at Buffalo Gap. The Wasta station has been discontinued.

Some decline in violations is manifest by a drop from 9 to 7 from the first to second period. Phosphorous is generally available along the segment and, contrary to downstream segments, nitrogen is also generally abundant. Salinity is a routine violation along the segment. Suspended solids violations were noted near Eagle Butte.

Intense salinity events are noted along the segment. Numerous mercury, lead, copper and zinc events were noted near Eagle Butte where isolated aluminum, chrominum, nickel and cyanide events were also observed.

Continued heavy metals events make it doubtful that this reach will be a viable fishery and severe salinity may limit the usefulness for man further. It is doubtful that this reach will meet 1983 goals unless heavy metals violations are sharply curtailed.

A group-by-group violations percentage summary indicates:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	3.2	0
II. Bac-T	0	0
IIIa. Nitrogen	47.4	60.6
IIIb. Phosphorous	70.4	69.7
IV. Phys./Aesth.	40.8	35.9

f. Big Sioux River - Headwaters to the Diversion Canal (Sioux Falls)

Quality is primarily affected by sediment introduced as a result of agriculture in the basin. Two major STP's and one major sand and gravel plant are located on this segment.

There is no data available at Watertown. Little or no D.O., BOD or Bac-T data is available below Brookings. Due to lack of data in the first period no trend is assessable.

Phosphorous is abundant along this segment. Nitrogen is occasionally available at Brookings but frequently found below Dell Rapids. Manganese was a persistent violation at Brookings.

Severe events data was lacking for heavy metals. One pH of 9.1 was observed at Dell Rapids. No salinity events were identified. Near no flow conditions are frequent.

It is presumed that this segment will meet 1983 goals assuming low flow and significant STP influents do not limit continued use as a warm water fishery.

Percentage violations are summarized below:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	ND	0
II.	Bac-T	ND	12.5
IIIa.	Nitrogen	69.0	50.0
IIIb.	Phosphorous	97.7	97.9
IV.	Phys./Aesth.	27.7	34.6

g. Big Sioux River from the Diversion Canal, Sioux Falls to Klondike Dam.

Upstream agriculatural uses, urban runoff as well as one major STP, and two power plants discharges impact quality.

Little or no D.O., BOD, or Bac-T data is available at Brandon.

Although no trend is assessable due to insufficient data, general quality appears poor as shown by a recent 22 Index value. Phosphorous is abundant in this segment and sufficient nitrogen to support abundant algal growth is found in nearly one of every two observations. Salinity violations are routine and some chloride excesses were also noted. Fecal Coliform violations were observed in nearly all samples at the North Cliff Avenue station.

Unionized ammonia events were frequent. Salinity events also underscored marginal conditions.

Assuming adequate sewage treatment this segment should meet 1983 goals although salinity may retard its full usefulness.

Percentage violations are summarized below:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	ND	0
II. Bac-T	ND	85.7
IIIa. Nitrogen	57.6	38.2
IIIb. Phosphorous	97.1	100
IV. Phys./Aesth.	36.6	42.7

h. Big Sioux River from the Klondike Dam to the (Iowa) Stateline.

Quality is principally a product of upstream uses for agriculture, municipal returns and industrial discharges.

Only one South Dakota station is available on this long segment and it has data for the second period only. Little or no PHS or toxic data was available. One intensive survey in February, 1972 has a large block of data in STORET.

No trend is assessable because of insufficient data but one 33 Index value suggests use scrutiny of this apparently degraded condition. Phosphorous and salinity violations are near or at 100%. Nitrogen is generally available - total and fecal coliform and D.O. violations were occasionally found.

Several severe D.O. violations were observed. Other severe events were noted for salinity. It is assumed this reach will meet 1983 goals if upstream abuses are corrected.

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	NO TREND DATA	10.7
II. Bac-T		32.1
IIIa. Nitrogen		54.6
IIIb. Phosphorous		100
IV. Phys./Aesth.		48.9

i. James River from the North Dakota border to the Diversion Dam.

Quality is affected by reservoirs in North Dakota as well as upstream non-point discharges. Farming and ranching as well as feedlots in this segment affect quality. Channel characteristics create some reverse flows and slow time of travel. One major STP is located on a near tributary.

No BOD data is available. D.O. data is collected at Hecla only and no Bac-T data is available at Columbia.

Marginal quality is suggested in each period by a rating of 11 and 12 respectively. Phosphorous is abundant and nitrogen generally available. Summer D.O. violations were monitored at Hecla. Salinity violations are frequent at Hecla and nearly 100% in violation at Columbia. TSS vioaltions at Hecla and manganese violations at Columbia have been noted. The State of South Dakota noted iron violations along this segment.

Severe salinity events were observed at Columbia. One pH event of 9.2 was noted at Hecla. Little or no PHS or toxic event data was found at either station.

In the absence of toxic data and in light of D.O. violations it is questionable whether this reach will meet 1983 goals.

Violations percentages are grouped below:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	7.7	12.5
II. Bac-T	0	0
IIIa. Nitrogen	46.7	54.6
IIIb. Phosphorous	96.2	94.3
IV. Phys./Aesth.	24.3	25.3

j. James River from the Diversion Dam to Huron.

This reach is affected by diversions to storage reservoirs and upstream effects of North Dakota reservoirs as well as agricultural uses; especially feedlots. Channel characteristics cause slow time of travel and permit backflow.

No data is available for this segment and consequently no trend is assessable.

Attainment of 1983 goals remains questionable at this time.

k. James River from Huron to the Missouri River.

This segment's quality is largely a function of upstream diversions and agriculturally related returns. Two major STP's and feedlots as well as other agricultural uses directly affect quality.

The station at the Huron WTP has been relocated downstream of the city. No D.O., BOD or Bac-T data is available at Mitchell.

Significant decline in quality is indicated by a 14 to 21 rating respectively. Some of the decline is attributable to relocating the Huron station; nevertheless, general quality is poor. Phosphorous is abundant and nitrogen is generally available along this segment, except at Scotland where nitrogen is generally unavailable. Salinity is a routine violation. Numerous manganese violations are indicated and iron has been cited by the State of South Dakota as a problem. Fecal coliform is a frequent violation below Huron. BOD violations are also seen below Huron. D.O. has violated State standards several times at Scotland - where a 0.0 mg/l D.O. event was observed.

Severe events for salinity occurred in nearly one of every two samples. High pH's (above 9.0) were observed below Huron and at Scotland. Unionized ammonia below Huron and mercury events at Scotland were also noted. One PHS event for selenium was observed at Huron. Low flow was a frequent occurrence along the segment.

Extensive efforts will be required to meet 1983 goals. Salinity and low flow will probably remain as limiting factors in the forseeable future. Percent violations of each Index group is as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	11.7	3.2
II. Bac-T	10.3	4.9
IIIa. Nitrogen	28.3	37.0
IIIb. Phosphorous	100	100
IV. Phys./Aesth.	44.6	39.2

1. South Dakota Lakes (Lake Oahe, Lake Francis Case, and Big Stone Lake)

Lake Oahe is a predominant feature of the northwest central part of the State and is a major factor in water quality in the Upper Missouri. No major discharges are located on the lake. One tributary major mining discharge apparently affects quality in the Cheyenne Arm. A large irrigation diversion upstream at Garrison Dam to the Souris and Red River of the North Basins is proposed. Lake Francis Case along with Lewis and Clark Lake dominate water quality in the lower South Dakota reach of the Missouri River. No major discharger is located on the lake. Big Stone Lake is located in the northeast corner of the State. It is a natural lake which is part of the headwaters system for the Minnesota River. No major dischargers are located on the lake.

Little data is available on Lake Oahe or Lake Francis Case. No data is available for Lake Francis Case in the second period.

No trend data is available on these three lakes, however, full impact of upstream irrigation diversions on Lake Oahe are as yet undefined, however, increased salinity loads will result.

Overall little or no PHS or toxic data was available on any of these South Dakota lakes.

Phosphorous is generally available but nitrogen is usually short on all three lakes. Salinity is a frequent violation on Big Stone Lake and to a lesser extent at Lake Francis Case.

Severe mercury events were observed on Lake Oahe; one unionized ammonia event was observed on Big Stone Lake. Algal blooms have been observed in Big Stone Lake. No events were detected on Ft. Randall.

It is presumed that all three of these lakes will meet 1983 goals but more data is needed for a firm judgement. Group-by-group percentage violations for each lake are summarized below:

Big Stone Lake Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	5.9
II. Bac-T	ND	ND
IIIa. Nitrogen	0	0
IIIb. Phosphorous	42.9	58.3
IV. Phys./Aesth.	26.0	26.3

Oahe Lake Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	ND	0
II. Bac-T	ND	ND
IIIa. Nitrogen	ND	12.5
IIIb. Phosphorous	ND	25.0
IV. Phys./Aesth.	12.5	6.2

Francis Case Lake Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	ND	NO DATA
II. Bac-T	ND	
IIIa. Nitrogen	ND	
IIIb. Phosphorous	ND	
IV. Phys./Aesth.	50	

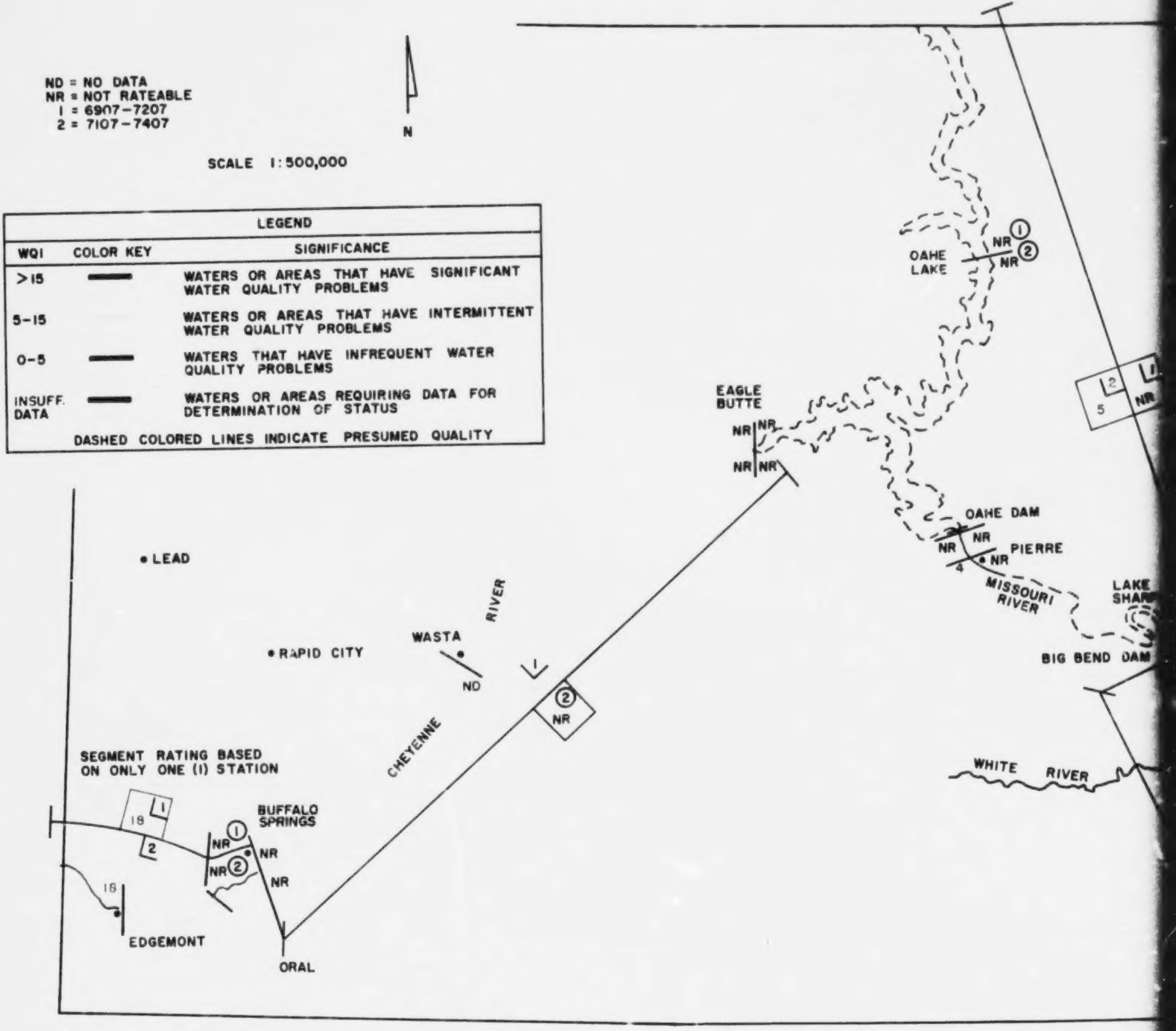
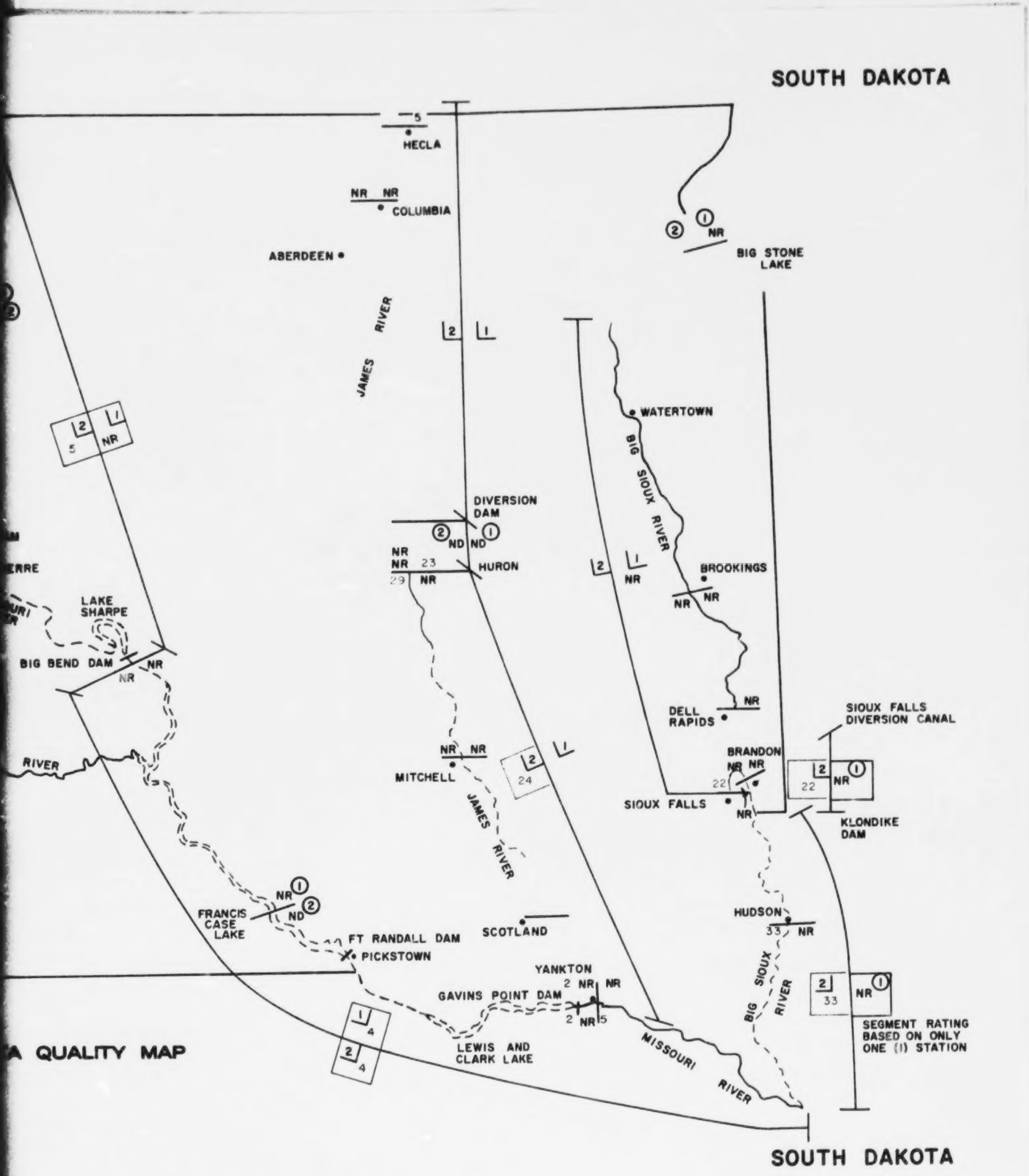

ND = NO DATA
NR = NOT RATEABLE
1 = 6907-7207
2 = 7107-7407
N
SCALE 1:500,000
LEGEND
WQI
COLOR KEY
SIGNIFICANCE
>15
WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15
WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5
WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
INSUFF. DATA
WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS
DASHED COLORED LINES INDICATE PRESUMED QUALITY
OAHE LAKE
NR ①
NR ②
EAGLE BUTTE
NR NR
NR NR
2
1
5 NR
OAHE DAM
NR
NR
PIERRE
NR
4
MISSOURI RIVER
LAKE SHAR
BIG BEND DAM
LEAD
RAPID CITY
WASTA
RIVER
ND
1
②
NR
CHEYENNE
WHITE RIVER
SEGMENT RATING BASED ON ONLY ONE (I) STATION
18
1
2
BUFFALO SPRINGS
NR ①
NR ②
NR
NR
18
EDGEMONT
ORAL

FIGURE 6 SOUTH DAKOTA QUALIT

A


SOUTH DAKOTA
HECLA
5
NR NR
COLUMBIA
ABERDEEN
JAMES RIVER
2
1
BIG STONE LAKE
② ① NR
2 1 5 NR
DIVERSION DAM
② ND ND ①
NR NR 23 29 NR
HURON
WATERTOWN
BIG SIOUX RIVER
BROOKINGS
2 1 NR
NR NR
ERRE
LAKE SHARPE
BIG BEND DAM
NR NR
RIVER
DELL RAPIDS
NR
SIOUX FALLS DIVERSION CANAL
BRANDON
NR NR
22
SIOUX FALLS
NR
2 ① 22 NR
KLONDIKE DAM
NR NR
MITCHELL
2 1 24
JAMES RIVER
NR ① ND ②
FRANCIS CASE LAKE
FT RANDALL DAM
PICKSTOWN
SCOTLAND
HUDSON
33 NR
YANKTON
2 NR NR
GAVINS POINT DAM
2 NR 5
2 33 NR ①
SEGMENT RATING BASED ON ONLY ONE (1) STATION
1 4
2 4
LEWIS AND CLARK LAKE
MISSOURI RIVER
BIG SIOUX RIVER
A QUALITY MAP
SOUTH DAKOTA

★ U.S. Government Printing Office: 1976-682-836

5. Utah.

a. Jordan River. Utah Lake to the Utah County Line.

Quality is primarily based on the quality of Utah Lake. There are some diversions for irrigation. Channel characteristics create slow time of flow across this short stretch. Some springs augment flow.

No fecal coliform data is available. Little or no data other than BOD and total coliform is available in the first period.

General quality is marginal as highlighted by a second period 12 rating, however, no trend is assessable due to insufficient data in the first period. Phosphorous is abundant and nitrogen is sometimes available. BOD is a persistent violation. Salinity and turbidity are routine violations.

Copper and zinc events were detected on a few occasions. Isolated events for mercury, lead, selenium (PHS), pH (marginal) and residue were also observed.

It is questionable if this reach will meet 1983 goals unless Utah Lake quality is also significantly improved.

Violations percentage summaries are as follows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	8.7	26.7
II.	Bac-T	10.5	0
IIIa.	Nitrogen	ND	0
IIIb.	Phosphorous	ND	87.5
IV.	Phys./Aesth.	ND	19.1

b. Jordan River. Utah County Line to the Great Salt Lake.

Quality is positively impacted by irrigation diversions in the upper reach which often withdraws the major portion of the marginal Utah Lake supply water. Springs in the upper reach of this segment thus dominate quality below these diversions. Nine major STP dischargers dominate quality along the middle and lower reach. Power plant discharges in the lower reach and withdrawals for municipal use on major tributaries also affect quality. Irrigation returns to tributaries (primarily Utah Lake water) also cause changes in mainstem quality. Urban and storm runoff can significantly affect quality in the lower reach.

There is no D.O. data in the first period. Fecal coliform was monitored in the second period at only two stations. Many stations collect D.O., BOD and total coliform data only.

Apparent improvement in quality suggested by a decline from 63 to 54 in the Index is due almost entirely to the absence of D.O. data in the first period and the consequent lack of violations once monitoring was introduced in the second. (Individual station data is also skewed in the same manner.) Subsegmenting suggests that the lower reach below 2100 S. has declined in quality as manifest by a 66 and a 63 (deflated) rating respectively. Some improvement related to Bac-T improvements is shown in the segment from the Narrows to 2100 S. as reflected by a 59 and a 44 rating. Nitrogen and phosphorous are abundant along this entire segment. Salinity is a routine violation and chloride is sometimes violated below 12600 S. Except for the Bluffdale Road station, BOD is frequently in excess of the 5.0 mg/l State standard. Total coliform is a frequent violation above Sandy, intense below Murray, and a more intense violation from Murray to the Great Salt Lake. Turbidity is occasionally in excess along the segment but no distinct pattern is shown.

Numerous PHS violations, including sporadic lead and selenium, and to a lesser extent cadmium, were monitored along the segment. Zinc and some copper events were also highlighted. Unionized ammonia, although not frequently monitored, was noted to be in excess at scattered locations on several occasions. Salinity events are noteworthy along the segment and are most severe at 12600 S. and above Sandy but less so downstream. A single D.O. and pH event were observed at the Narrows station. Occasional temperature events were noted at Cudahy Lane. Oil and grease in the metropolitan area, presumably from storm sewers, has been cited by the State of Utah as a frequent problem.

In light of the numerous PHS and toxic violations, coupled with irrigation return flows, it is doubtful that this entire segment will meet 1983 goals.

Group violations percentages are given below:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	69.2	*43.0
II. Bac-T	76.9	60.2
IIIa. Nitrogen	95.1	87.2
IIIb. Phosphorous	93.6	96.5
IV. Phys./Aesth.	31.4	36.0

* Skewed by the presence of and lack of violations for D.O. in the second period.

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c. Colorado River from the (Colorado) stateline to Lake Powell.

Quality is affected by irrigation diversions and returns, and storage reservoirs and transmountain diversions in the State of Colorado. Non-point sources affect quality primarily via major tributaries along this segment. One major radioactive minerals processing industry is located on the mainstem and another is found on a State of Colorado tributary. One major STP is found far upstream on a major tributary. Quality in the lower reach of this segment is dominated by Lake Powell and inputs from major tributaries.

Little data is available at the Colorado-Utah stateline. No data is available to pinpoint the impact of the Green River or the general quality of Lake Powell. Data is irregularly collected.

Marginal quality is indicated by a 32 and 15 rating respectively. Turbidity and frequent coliform excesses were noted at Moab.

Evaluation of data on the segment from the Colorado-Utah border to Moab indicates that this segment is not likely to meet 1983 goals unless conditions materially improve. Additional data is required to fully assess the situation.

Grouped violation percentages shown:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	10.4	2.6
II. Bac-T	35.7	22.8
IIIa. Nitrogen	100.0	84.6
IIIb. Phosphorous	90.0	22.2
IV. Phys./Aesth.	30.5	21.0

d. Bear River. Headwaters to the (Wyoming) Stateline.

Quality is somewhat affected by a small reservoir and some diversions for irrigation.

No data is available. No trend is assessable in the absence of data and the 1983 goal projection must remain questionable.

e. Bear River from Utah (back) into Wyoming.

Quality is affected by irrigation diversions and one (seasonal) significant STP discharge in Wyoming.

No data is available and no trend is assessable, and the 1983 goal projection must remain questionable.

f. Bear River from the Idaho-Utah Stateline to the Great Salt Lake.

Quality is affected by diversions to the Bear Lake storage reservoir, power projects, many irrigation diversions and returns both on the mainstem and tributaries, and other storage reservoirs on the mainstem and tributaries. Major tributary dischargers include one seasonal sugar refinery effluent, and one packing plant wastewater discharge. One major STP is located on the lower reach and one major STP is situated far upstream on a tributary.

Both the Cornish and Cub River stations have apparently been discontinued. Little severe event data is available in either period. D.O. data in the second period is limited to the Bird Refuge station. Data is generally lacking on this segment for a comprehensive review. Improved Bac-T and BOD have contributed to improved quality as shown by an Index decline from 32 to 18 on this segment. Nitrogen and phosphorous are generally available along the segment. Salinity is often violated, especially at the Bird Refuge. Frequent total coliform and some fecal coliform and BOD violations were sited at Amalga. One pH event at Amalga and one cadmium event at Richmond were observed. Non-point sources have been mentioned by the State of Utah as contributing to temperature problems and general degradation of quality in the Basin.

The segment may meet 1983 goals, however, close scrutiny of point and non-point pollution must be maintained.

Violations percentages are summarized below:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	14.1	8.0
II. Bac-T	32.1	15.3
IIIa. Nitrogen	64.3	33.3
IIIb. Phosphorous	84.6	58.3
IV. Phys./Aesth.	29.6	21.5

g. Weber River. Headwaters to Highway 40 at Plain City.

Quality is dominated by irrigation diversions as well as five (5) storage reservoirs in the upper reach. There is some upper reach diversions to the Provo River. During the height of the irrigation season "no flow" conditions are not uncommon in the lower reach. One major STP and metropolitan area runoff affect quality in the lower reach.

No data is available from the headwaters to Gateway. Little or no D.O., BOD or Bac-T data is available at Gateway. Most data was found above and below the Central Weber STP. No nitrogen or phosphorous data is available below the Central Weber STP. D.O. data is available in the second period only. There is very little severe event data in either period.

General improvement is suggested in a Index drop from 21 to 10. This improvement is skewed somewhat by the appearance and lack of D.O. data violations in only the second period, however, BOD, nitrogen and salinity quality did improve. Limited data reveals that Gateway has little eutrophication potential but that above Central Weber this situation is reversed. Total and fecal coliform violations are frequent above the Central Wever STP. Septic tank and highway run-off were cited by the State of Utah as impacting quality along this segment.

Conditions in the lower reach remain questionable but it is probable that with continued abatement efforts this reach will meet 1983 goals. However, no-flow conditions cannot persist. Grouped percentage violations show:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	28.6	9.8
II. Bac-T	33.3	35.6
IIIa. Nitrogen	55.6	9.7
IIIb. Phosphorous	34.5	30.0
IV. Phys./Aesth.	5.1	2.7

g. Weber River from Plain City to the Bird Refuge.

This very short reach of meandering streams is subject to frequent no-flow conditions due to upstream diversions.

No D.O., BOD or Bac-T data is available.

No trend is assessable due to lack of data. Phosphorous is abundant and nitrogen generally so. Infrequent salinity excesses were noted in the second period only. Excessive manganese was noted several times on the Middle Fork.

No pH or temperature events were noted. No PHS or toxic data was available.

In the absence of flow augmentation this segment will not be able to support fish life and its use for body contact recreational purposes is doubtful.

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	ND	ND
II. Bac-T	ND	ND
IIIa. Nitrogen	61.5	48.9
IIIb. Phosphorous	100.0	97.9
IV. Phys./Aesth.	4.6	3.5

i. Green River. Flaming Gorge to the (Utah-Colorado) Stateline.

Quality is dominated by impoundment effects and inputs to the Flaming Gorge Reservoir. Some transbasin diversions and diversions for irrigation affect upstream quality. Both Flaming Gorge Reservoir and this segment are subject to seasonal tourism.

No nutrient or physical/aesthetic data was available in the first period.

General quality seems adequate to meet 1983 goals No trend is assessable but a 7 rating in the second period is cause for concern. One summertime violation for total and fecal coliform was monitored in the first period. Data is generally scant. Salinity violations were observed in 2 of 5 samples.

No severe events were detected in either period.

It is expected that this segment will meet 1983 goals, however. bacterial and physical aesthetic quality has declined markedly from upstream conditions above the Flaming Gorge Reservoir.

Group percentage violation analysis indicates:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	6.9	6.7
IIIa. Nitrogen	ND	100.0
IIIb. Phosphorous	ND	20.0
IV. Phys./Aesth.	ND	8.6

j. Green River from the Colorado-Utah Stateline to the Colorado River.

Transmountain diversions out of the basin and significant irrigation uses on tributaries impact quality. Sedimentation from non-point sources occurs throughout the basin. Some storage in reservoirs on the tributaries adversely impact quality. One major STP is located on a tributary.

No D.O. data is available at Green River. Nitrogen and phosphorous are generally available.

Somewhat reduced quality is manifest by an Index rise from 9 to 11. Occasional salinity violations, intensifying at Green River, were observed. Total coliform standards were increasingly violated and found in nearly 1 of every 4 samples at Jensen and Green River in the second period. Few fecal coliform violations were detected. Frequent turbidity violations were highlighted at Green River but only occasionally upstream at Jensen.

Isolated copper and zinc events along with several cadmium excesses were detected at Green River. Marginal pH excesses were noted along the segment. High boron in Strawberry Springs and salinity from Crystal Geyser were cited as water quality problems in the basin by the State of Utah.

This segment is expected to meet 1983 goals although turbidity and total coliform violations must be controlled if full usefulness is expected.

Violation percentages for each Index group shows:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	0	1.9
II.	Bac-T	7.5	14.5
IIIa.	Nitrogen	67.9	50.0
IIIb.	Phosphorous	39.3	43.2
IV.	Phys./Aesth.	18.8	13.6

k. Utah Lake.

Quality is affected by shallowness, irrigation diversions on tributaries; especially the Provo River, reservoir impoundments and some transmountain diversions. Two major STPs located near the lake impact quality. One large steel mill discharge is also located on the lakeside. One major tar and chemical industry and a cast iron plant on a nearby tributary also affect quality. A large, proposed transmountain diversion, if implemented, will further impact quality.

No data is available in the second period. No D.O., BOD or Bac-T data is available in the first period.

No trend is assessable, however, phosphorous was abundant and nitrogen was available in 1 of every 2 samples. Salinity was violated in 100% of the samples. Turbidity is a frequent violation.

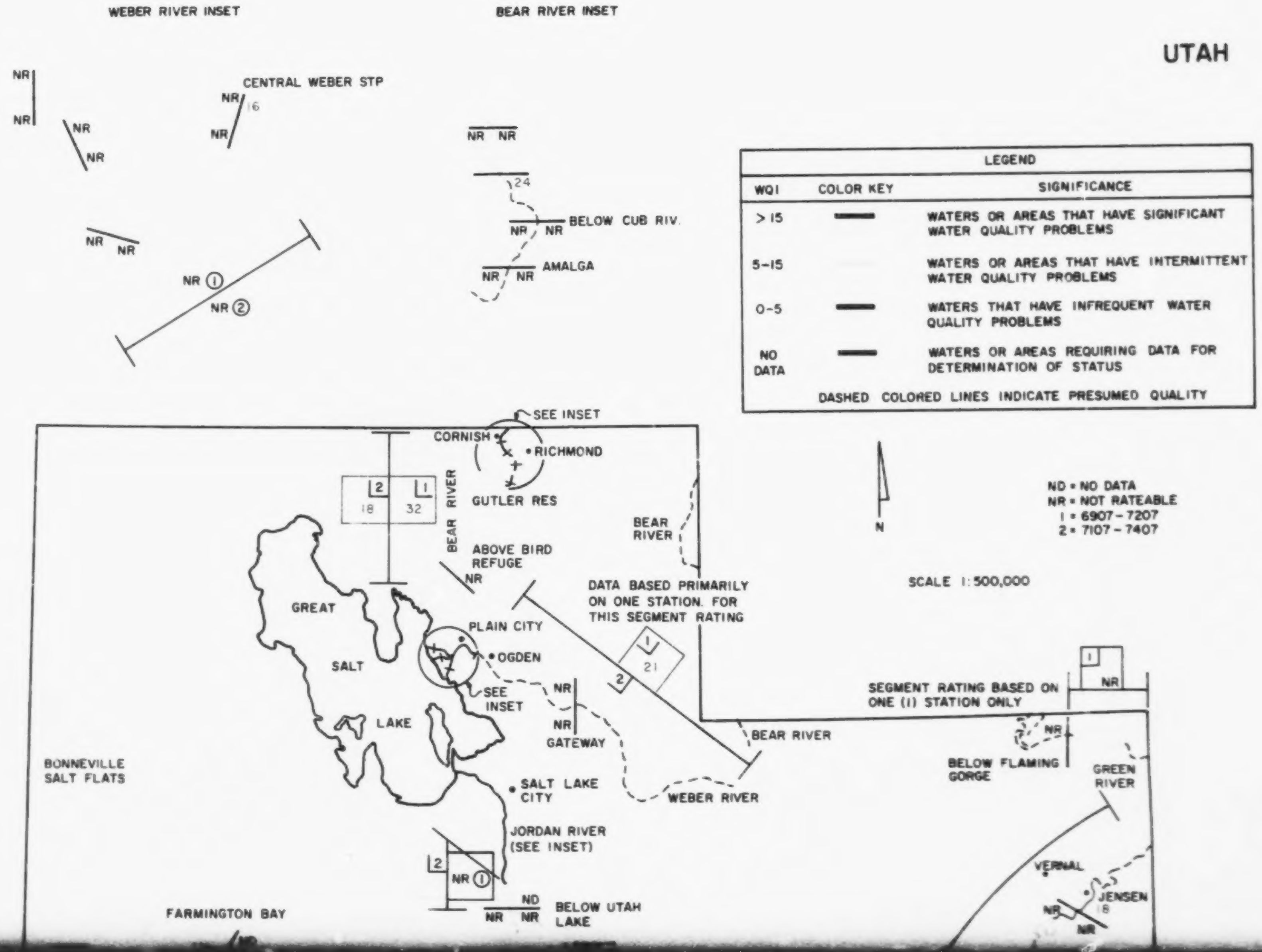
Scattered severe events for copper, zinc and cadmium were observed. One severe salinity event was monitored. No PHS, temperature or pH events were highlighted.

Low and no-flow conditions on several major triburaries coupled with further proposed diversions, and present eutrophic conditions make it doubtful that this lake will meet 1983 goals regarding fish and related uses. High salinity may limit the usefulness for other purposes as well.

Grouped violations percentages for Index data highlights:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	ND	No Data
II. Bac-T	ND	
IIIa. Nitrogen	60.0	
IIIb. Phosphorous	97.8	
IV. Phys./Aesth.	26.6	

UTAH


WEBER RIVER INSET
NR
NR
NR
NR
CENTRAL WEBER STP
NR
16
NR
NR
NR
NR ①
NR ②
BEAR RIVER INSET
NR NR
24
NR NR BELOW CUB RIV.
NR NR AMALGA
SEE INSET
CORNISH
RICHMOND
2
1
18
32
BEAR RIVER
GUTLER RES
ABOVE BIRD REFUGE
NR
BEAR RIVER
DATA BASED PRIMARILY ON ONE STATION. FOR THIS SEGMENT RATING
1
21
2
GREAT
SALT
LAKE
PLAIN CITY
OGDEN
SEE INSET
NR
NR
GATEWAY
BEAR RIVER
WEBER RIVER
SALT LAKE CITY
JORDAN RIVER (SEE INSET)
2
NR ①
ND
NR NR
BELOW UTAH LAKE
BONNEVILLE SALT FLATS
FARMINGTON BAY
N
SCALE 1:500,000
SEGMENT RATING BASED ON ONE (1) STATION ONLY
1
NR
NR
BELOW FLAMING GORGE
GREEN RIVER
VERNAL
JENSEN
18
NR
NR

ND = NO DATA
NR = NOT RATEABLE
1 = 6907 - 7207
2 = 7107 - 7407

LEGEND

WQI	COLOR KEY	SIGNIFICANCE
> 15	▬	WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15		WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5	▬	WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
NO DATA	▬	WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS

DASHED COLORED LINES INDICATE PRESUMED QUALITY

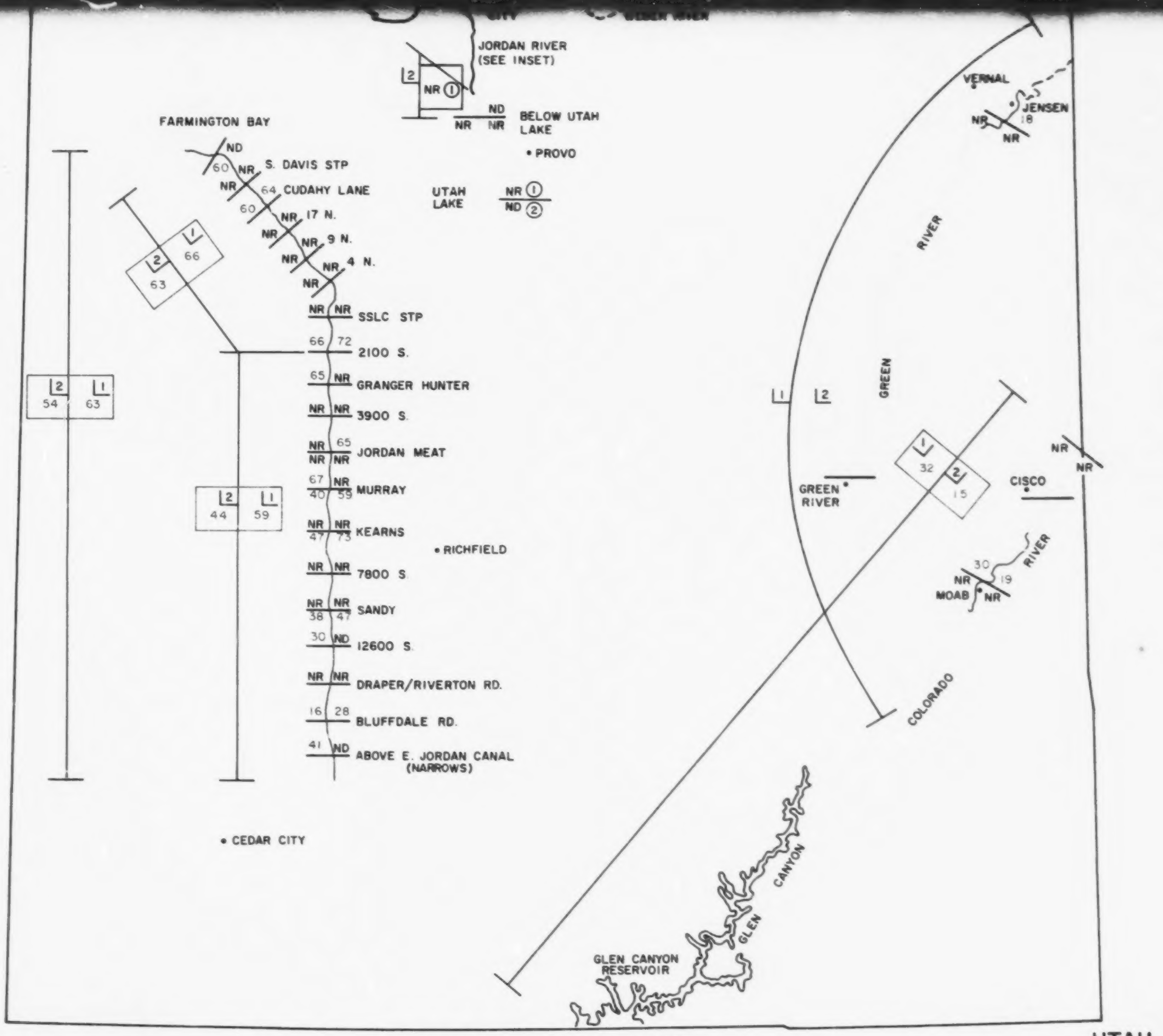

JORDAN RIVER
(SEE INSET)
NR ①
2
ND
NR
NR
BELOW UTAH LAKE
• PROVO
UTAH LAKE
NR ①
ND ②
FARMINGTON BAY
ND
60
NR
S. DAVIS STP
NR
64
CUDAHY LANE
60
NR
17 N.
NR
NR
9 N.
NR
NR
4 N.
NR
2
1
66
63
NR
NR
SSLC STP
66
72
2100 S.
65
NR
GRANGER HUNTER
NR
NR
3900 S.
NR
65
NR
NR
JORDAN MEAT
67
NR
40
59
MURRAY
NR
NR
47
73
KEARNS
NR
NR
7800 S.
NR
NR
38
47
SANDY
30
ND
12600 S.
NR
NR
DRAPER/RIVERTON RD.
16
28
BLUFFDALE RD.
41
ND
ABOVE E. JORDAN CANAL
(NARROWS)
2
1
54
63
2
1
44
59
• RICHFIELD
• CEDAR CITY
VERNAL
JENSEN
NR
18
NR
GREEN
RIVER
1
2
GREEN RIVER
1
32
2
15
CISCO
NR
NR
RIVER
30
19
NR
NR
MOAB
COLORADO
GLEN CANYON
GLEN CANYON RESERVOIR

FIGURE 7 UTAH QUALITY MAP

UTAH

★ U.S. Government Printing Office: 1976-682-836

6. Wyoming.

a. North Platte River.

Quality is affected by five major reservoirs and irrigation diversions and returns along the segment. Groundwater withdrawals and power development projects also impact quality. One major STP, a seasonal sugar refinery and power plant discharge are found on the mainstem. Two major uranium mines, and one iron processing industry are located in the basin.

Total coliform data was not analyzed since there is no state standard for this parameter. BOD data was only collected below Casper and at the Nebraska border stations. Little D.O., fecal coliform and phosphorous data was collected at other than these same two stations. Little or no PHS or toxic data was collected except for the station below Casper.

Some improved segment quality, due largely to improvements at the Nebraska border, is shown by a drop from 12 to 10 in the Index. Nitrogen is abundant below Casper and at Lingle (below the confluence with the Laramie River). Salinity violations were first noted below Casper but seem to be moderated somewhat up to Lingle, (although also peaking below Glendo Reservoir) but below Lingle to the Nebraska border violations became frequent again.

Zinc events were cited below Casper where marginal mercury violations were also detected. Several pH (marginal) violations were noted along the segment below Casper and, isolated; but high temperature events were observed below Casper.

It is expected that this segment will meet 1983 goals, however, conditions below Casper must improve significantly. Additional PHS and toxic data is required.

Group violation percentages show:

Index Group	Percent Violations 6907 - 7207	Percent Violations 6907 - 7207
I. ORB	0	0
II. Bac-T	40.9	30.0
IIIa. Nitrogen	43.9	28.7
IIIb. Phosphorous	60.0	46.2
IV. Phys./Aesth.	9.6	6.8

b. Wind-Bighorn River.

The Wind River segment quality is primarily affected by irrigation and power for the Riverton project, as well as Boysen Reservoir and several smaller reservoirs on the mainstem and tributaries. Irrigation diversions and returns are found along the mainstem and tributaries. One significant STP is located on the mainstem and one major uranium mine is found in the basin. The Bighorn reach is directly affected by agricultural use and returns along the mainstem and its tributaries, especially, the Greybull River, as well as the Yellowtail reservoir at the Montana Border. One seasonal sugar refinery discharge is located on the mainstem. A seasonal sugar refinery discharge is located on a tributary to Yellowtail Reservoir. Oil well discharges may, collectively, affect quality along this entire segment, and in the Yellowtail Reservoir.

No fecal coliform data was collected in the first period. BOD data was collected at Kane only in the second period. No D.O. or Bac-T data was collected at Lucerne or Worland. Thermopolis data collection was discontinued in the second period.

Although no trend is assessable, excellent quality is manifest by a 3 rating in the second period. No eutrophication potential was noted although phosphorous data was limited. Salinity violations were not noted at or above Riverton but violations are found below Boysen Reservoir and intensify to the Yellowtail Reservoir.

Severe event data for PHS and toxic related constituents is limited, except at Kane. One D.O. event was noted at Kane. Several marginal pH events were observed at Thermopolis and at other isolated locations along the segment.

Data is lacking to make an unqualified statement that this reach will meet 1983 goals, however, this is expected at this time. Increasing salinity may limit full usefulness of this segment and Yellowtail Reservoir as well.

Grouped violation percentages are as follows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	ND	0
IIIa. Nitrogen	2.0	3.8
IIIb. Phosphorous	29.4	18.2
IV. Phys./Aesth.	11.7	8.2

c. Green River.

Quality is affected primarily by irrigation diversions and returns. Fontenelle Reservoir in the upper reach and other storage reservoirs on tributaries also affect quality. One significant STP and a train maintenance yard discharge are located on the mainstem. Wastewater from an STP, and a proposed discharge from a trona mine are found in tributary waters.

No BOD data was collected on this segment. Fecal coliform data is available in the second period only. Little phosphorous data was collected. Little PHS or toxic data was collected in either period.

Unrateable in the first period excellent quality is indicated by a 1 Index value in the second with only few salinity, nitrogen, and turbidity violations. Numerous pH events were seen along the segment with one 9.1 value observed at La Barge.

Additional data is required for a reasonable assessment, however, this segment is expected to meet 1983 goals. Grouped index group highlighting percentage violations shows:

Index Group	Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I. ORB	0	0
II. Bac-T	ND	0
IIIa. Nitrogen	0	2.7
IIIb. Phosphorous	ND	0
IV. Phys./Aesth.	1.7	1.2

d. Powder River.

Quality is affected by numerous irrigation diversions and returns, non-point sources, and oil well discharges especially along Salt Creek.

Only physical-aesthetic data was available in the first period. BOD data was not available at Keycee in either period. No PHS or toxic data was available.

No trend assessment is possible, but, marginal quality is manifest by a 10 rating in the second period. No nitroger or phosphorous excesses were noted. Fecal coliform was frequently violated at Arvada where two low D.O. (winter) values were also noted. Numerous salinity violations were observed at Kaycee, and 100% salinity violations at Arvada, mostly at severe levels, were also observed. Some chloride and turbidity excesses were also noted at Arvada.

Several temperature events were measured at Kaycee and one isolated event at Arvada was also detected.

It is questionable that this reach will meet 1983 goals without flow augmentation, although additional data is required before any clear assessment to the negative is made for the entire segment. Salintiy conditions will continue to limit maximum usefulness.

Summary data for percentage violations of Index groups manifests:

Index Group		Percent Violations 6907 - 7207	Percent Violations 7107 - 7407
I.	ORB	ND	9.1
II.	Bac-T	ND	37.5
IIIa.	Nitrogen	ND	0
IIIb.	Phosphorous	ND	0
IV.	Phys./Aestn.	47.1	33.8

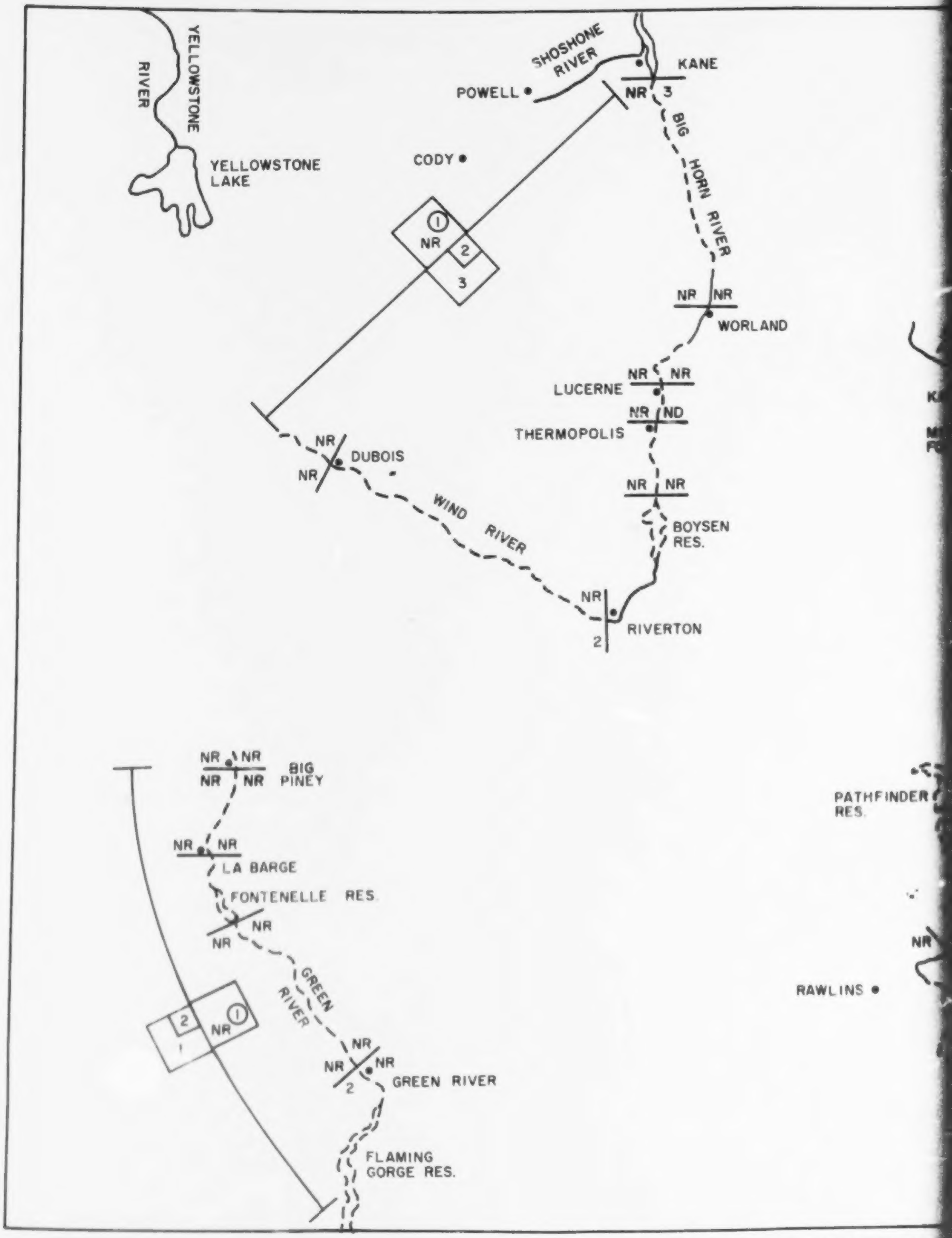
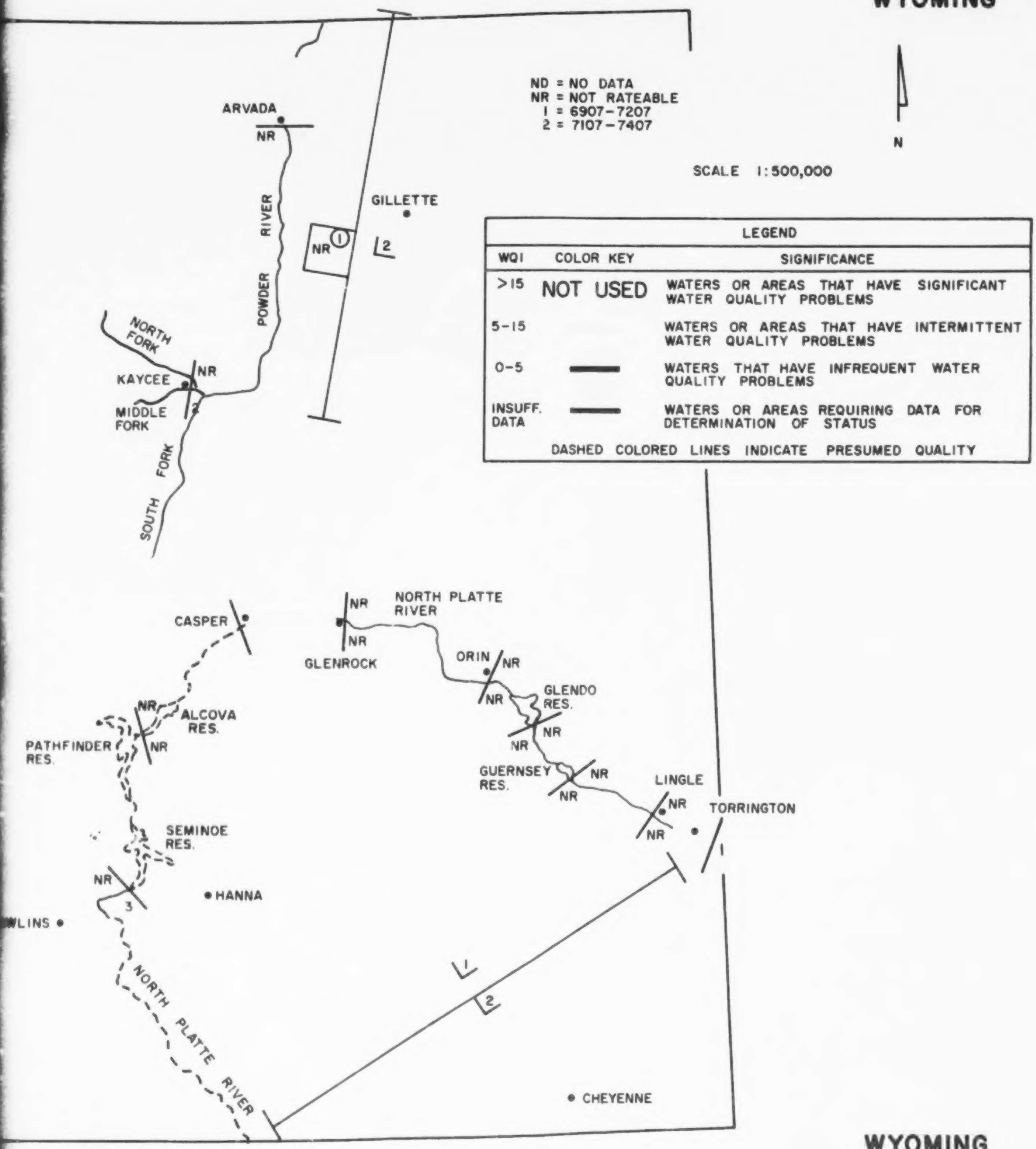

YELLOWSTONE RIVER
YELLOWSTONE LAKE
SHOSHONE RIVER
KANE
POWELL
NR
3
BIG HORN RIVER
CODY
1
NR
2
3
NR
NR
WORLAND
NR
NR
LUCERNE
NR
ND
THERMOPOLIS
NR
NR
BOYSEN RES.
NR
NR
DUBOIS
WIND RIVER
NR
2
RIVERTON
NR
NR
NR
NR
BIG PINEY
NR
NR
LA BARGE
FONTENELLE RES.
NR
NR
GREEN RIVER
2
NR
1
1
NR
NR
NR
NR
2
GREEN RIVER
FLAMING GORGE RES.
PATHFINDER RES.
NR
RAWLINS

FIGURE 8 WYOMIN

WYOMING


N
ARVADA
NR
POWDER RIVER
GILLETTE
NR
1
2
NORTH FORK
KAYCEE
NR
MIDDLE FORK
2
SOUTH FORK
CASPER
NORTH PLATTE RIVER
NR
NR
GLENROCK
ORIN
NR
NR
GLENDO RES.
NR
NR
ALCOVA RES.
NR
NR
PATHFINDER RES.
GUERNSEY RES.
NR
NR
LINGLE
NR
NR
TORRINGTON
SEMINOE RES.
NR
3
HANNA
WLINS
1
2
NORTH PLATTE RIVER
CHEYENNE

ND = NO DATA
NR = NOT RATEABLE
1 = 6907-7207
2 = 7107-7407

SCALE 1:500,000

LEGEND		
WQI	COLOR KEY	SIGNIFICANCE
>15	NOT USED	WATERS OR AREAS THAT HAVE SIGNIFICANT WATER QUALITY PROBLEMS
5-15		WATERS OR AREAS THAT HAVE INTERMITTENT WATER QUALITY PROBLEMS
0-5	▬	WATERS THAT HAVE INFREQUENT WATER QUALITY PROBLEMS
INSUFF. DATA	▬	WATERS OR AREAS REQUIRING DATA FOR DETERMINATION OF STATUS

DASHED COLORED LINES INDICATE PRESUMED QUALITY

WYOMING QUALITY MAP

WYOMING

7-75

★ U.S. Government Printing Office: 1976-682-836

VIII. Data Review

A. Overview

Generally data is lacking to provide a reasonably complete review. Lake (including reservoir) data and groundwater data are especially in need of programs to provide this coverage. Data needs regarding non-point sources need to be better identified and monitoring stations established accordingly.

B. Station Gaps

Apparent stations where needs do not coincide with available data are as follows:

1. Colorado

The Colorado River from Cameo to Fruita needs data to define the impact of the city of Grand Junction, heavy irrigation use, and the Gunnison River. Data is needed on the upper Rio Grande River (near Creede) to assess the impact of mining activities. On the Arkansas River below Pueblo to Nepesta data is required to define the combined effect of Fountain Creek, the city of Pueblo and CF&I Steel. Along the South Platte River between Henderson and Kersey data is needed to describe the effect of feedlots, irrigation uses and tributaries.

2. Montana

The Missouri River at the headwaters and also near Great Falls, needs data to define quality and to determine the impact of the city of Great Falls' STP and industrial dischargers. On the Clark Fork

River between Deer Lodge and Missoula data is needed to define the effect of mining activities and the city of Missoula's STP discharge, as well as a paper-pulp mill discharge at Missoula. Below Moorhead the Powder River needs data to determine point and non-point effects.

3. North Dakota

Much supplementary data on the Missouri River and its reservoirs is needed to assess general quality. Data on the James River above Jamestown is needed to determine background quality and the impact of impoundments and diversions.

4. South Dakota

On the Big Sioux above Dell Rapids and below Brandon data is required to define general quality and irrigation effects. Data is desireable on the Cheyenne River below the Angostura Reservoir to define the effects of irrigation and other non-point sources. Supplemental data on the James River is needed, except near Huron and Hecla and below Scotland; and on the Missouri River and its reservoirs.

5. Utah

No data is available at the headwaters of the Bear and Weber Rivers to define background quality. Data on the Glen Canyon Reservoir is required to determine the effects of tributaries and main-stem uses along the Colorado River in Utah. Supplemental data is required on the Green River between Jensen and Green River as well as on the Bear

River from Richmond to the Bird Refuge.

6. Wyoming

Much supplemental data is needed along the North Platte, except below Casper and Torrington; especially below reservoirs, to determine background quality and effects of impoundments, etc.. Supplemental data is required at trend locations on the Green River, and the Wind-Bighorn River, to determine background effects and general influence of point and non-point discharges, especially near Worland and at the Yellowtail Reservoir.

C. Duplication.

Strange, in light of the general need for additional data, is the apparent duplication of data at stations in Colorado and North Dakota, and to some extent in South Dakota and Utah as well - at least up to July 1, 1974.

Coordination between agencies that may still collect duplicate data must be undertaken to avoid equivalent-duplicate monitoring. Resources made available can be allocated to areas that have little or no monitoring or to parameters at the same locations, for example, heavy metals, pesticides, chlorophyll or biological indicators, that are lacking.

Duplication of some data is suggested at the following locations: (Duplicating agencies are shown in parenthesis.)

1. Colorado

   a. South Platte River at Henderson
      (Colo-USGS)

   b. South Platte River at Julesburg
      (Colo-USGS)

   c. Colorado River at Hot Suphur Springs
      (Colo-USGS)

   d. Colorado River at Dotsero
      (Colo-USGS)

   e. Arkansas River at Canon City
      (Colo-USGS)

   f. Arkansas River above Pueblo
      (Colo-USGS)

   g. Arkansas River at Lamar
      (Colo-USGS)

2. Montana

None

3. North Dakota

a. Missouri River below Garrison Dam
(Corps of Engineers-USGS)

b. Red River of the North near Wahpeton
(N.D.-Minn.-USGS)

c. Red River of the North at Fargo
(N.D.-Minn.-USGS)

d. Red River of the North at Grand Forks
(City-N.D.-Minn)

e. Red River of the North at Oslo
(Minn.-USGS)

f. Red River of the North at Pembina
(N.D.-Minn.-USGS)

g. Souris River at Minot
(N.D.-USGS)

h. Souris River at Westhope
(N.D.-USGS)

i. James River at La Moure
(N.D.-USGS)

4. South Dakota

a. Missouri River at Yankton
(Corps of Engineers-USGS)

b. Cheyenne River at Eagle Butte
(Corps of Engineers-USGS)

5. Utah

Colorado River at Jensen
(Utah-USGS)

6. Wyoming

None

D. Summary of Parameter Gaps.

Within the salinity related sub-group chloride data coverage was spotty and no sulfate data was found. In the aesthetic related group, little methylene blue active substances (MBAS), carbon chloroform extractables (CCE), or phenol data was found. No in-stream chlorine, or hydrogen sulfide data was available. Very little data was available for radiologically-related parameters.

Parameter coverage was somewhat spotty in the most recent trend period. Specifically, there was no Bac-T data on the Missouri River below Fort Peck Dam, on the Cheyenne River from the Fall River to its confluence with the Missouri River nor on the Weber River below Plains City. Both ORB and Bac-T data were unavailable on the Bighorn River from the Wyoming-Montana border to Hardin, Montana or on the Cheyenne River below the Angostura Reservoir to Fall River, South Dakota. ORB data on the Weber River below Plain City was absent except for one (1) D.O. observation. Nutrient data for both nitrogen and phosphorous was very limited on the Green River below the Flaming Gorge Reservoir. Phosphorous data was lacking along three Wyoming watercourses, namely, the Wind-Bighorn River, Green River and Powder River.

As stated in the segment review, five segments, namely the Clark Fork River from Cottonwood Creek to the Little Blackfoot River, the James River from the Diversion Dam to Huron, South Dakota, both upstream Bear River segments in Utah, and the Missouri River from the Sun River to Rainbow Dam had no data collected in the most recent trend period.

IX. Flow

A. Flow Adjustment.

Beyond the usual disclaimer that "these standards do not apply below the 7 day - 10 year low flow" flow is not directly considered by state standards. (South Dakota exempts its high quality waters for the 7 day - 25 year low flow.) North Dakota has no 7 day - 10 year low flow exemption but can require additional treatment during low flow, Utah has no flow restrictions, and North Dakota exempts its turbidity standards for Class III waters if due to heavy runoff. Colorado, Montana, and Wyoming utilize "not to increase by" standards for turbidity thus indirectly considering flow.

During this review no state standard violations were exempted due to low flow conditions. Reasoning for this was twofold; one, on no occasion did the limited, instantaneous flow data drop below the 7 day - 10 year (or 7 day - 25 year low flow) and secondly, data was unavailable for assessing conditions "above background".

In the absence of comprehensive flow-tied water quality data, trends or insights were sought with the available data by examining the relationship between the Index and mean flow values. After compiling percent change in mean flow and the corresponding percent change in the Index a simple linear regression analysis was conducted for each of four cases with flows greater and less than 1,000 cfs, and Index values greater and less than five. (As it turned out sensitivity for

Index values less than five did not yield a good trend line. Trend lines were nearly identical for flows greater and less than 1,000 cfs so these conditions were merged.) Then, using the trend line for the twenty-five (25) stations that had sufficient flow data (a minimum of 20 observations) and an Index rating in both periods each, it was seen that the Index intercept had shifted, minus, 10.7 percent from the first to the second periods. This shift implies, but by no means verifies, a general improvement of this same dimension for these stations. Graphically the regression analysis is shown in Figure 9.

Adjustments for flow were made at each station according to the regression formula. Of the twenty-five (25) stations, only four (4) seemed to require significant adjustment. Apparent improvement at the Cheyenne River at Edgemont; Jordan River at 2100 South; and the North Platte River at Casper were seemingly due to flow increases. Significant improvements on the South Platte at Julesburg were diminished somewhat by the flow adjustment. Compensations are summarized in Table 13.

This empirical exercise is an attempt to deal with flow given the limited quantities of flow-quality tied data. What is hoped is that later surveys can directly assess the impact of flow relationships, at least for primary trend stations, by having adequate data available at which time a more direct method, like the approach used by the Council on Environmental Quality, (non-parametric-frequency analysis) for its 1972 annual report could be used.

Figure 9

Regression Line for % Change of
WQI (>5) vs. Mean Flow
From 6907 - 7207 to 7107 - 7407

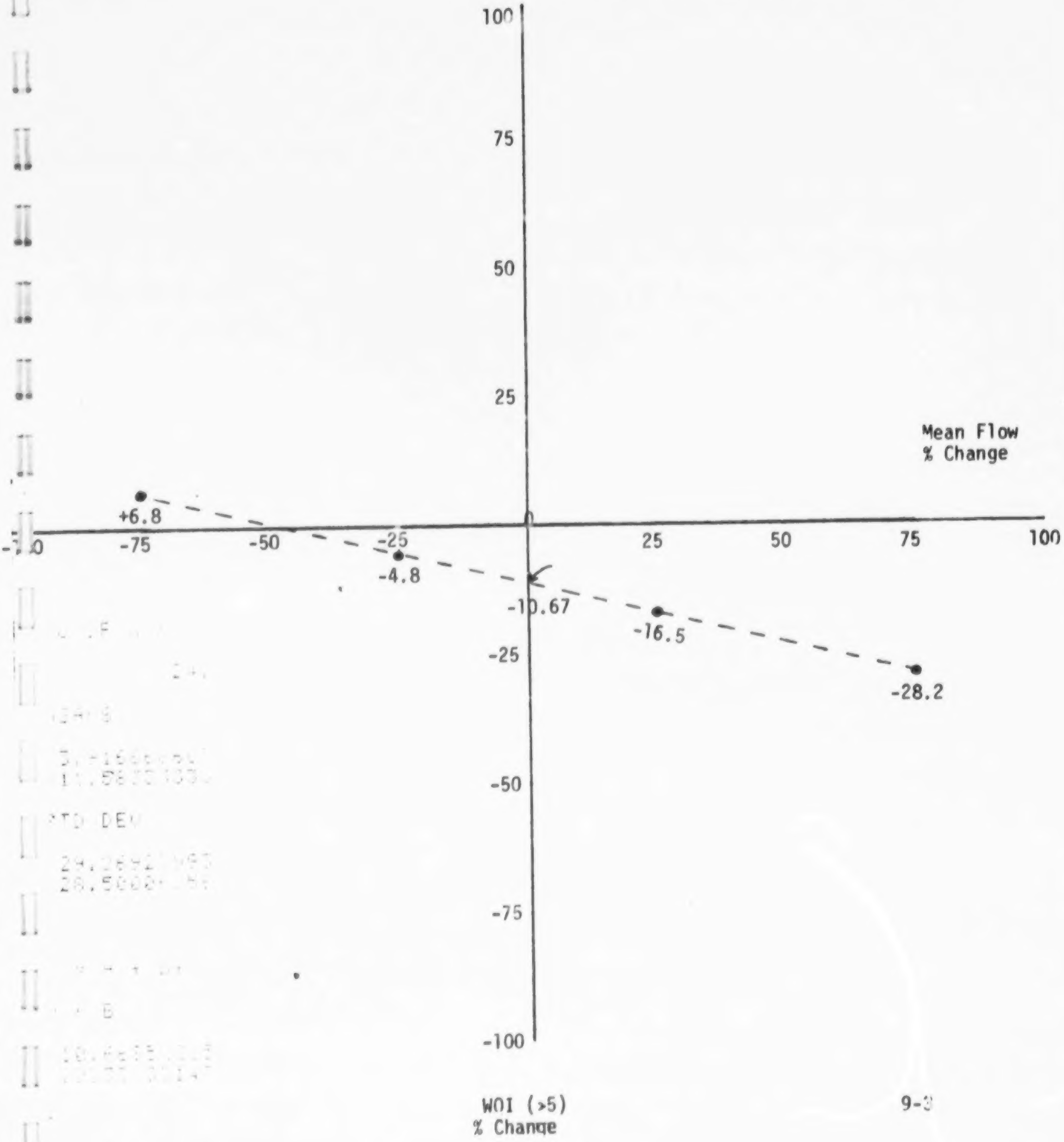


Table 13

Flow Compensated Index At
Flow Less Than 1000 cfs. & Index Greater Than 5

* Significant shift

Watercourse	Location	WQI Actual 6907-7207/7107-7407	7107 - 7407 Flow Adjust.	Actual	Flow & Trend Compensated Change
South Platte River	Henderson	56/43	+0	-13	-13
	Henderson	55/55	+0	0	0
	Julesberg	35/12	+6	-23	-17 *
Arkansas River	Below John Martin	10/11	+2	+1	+3
	Lamar	12/12	+2	0	+2
	Lamar	15/10	+2	-5	-3
	Coolidge	24/13	+2	-11	-9
Bighorn River	Hardin	12/8	+1	-4	-3
Red River of the North	Fargo	25/12	+4	-13	-9
	Fargo	9/10	+2	+1	+3
	Fargo	16/10	+3	-6	-3
	Grand Forks	11/7	+1	-4	-3
	Grand Forks	22/11	+1	-11	-10
	Oslo	18/13	+2	-5	-3
	Drayton	9/9	0	0	0
Souris River	Minot, N.D.	16/16	0	0	0
	Verendrye	26/23	0	-3	-3
Cheyenne River	Edgemont	18/14	+4	-4	0 *
James River	Scotland	8/11	0	-3	-3
Jordan River	2100 S.	72/66	+8	-6	+2 *
Green River	Jensen	12/18	+2	+6	+8
	Green River	9/12	+1	+3	+4
North Platte River	Casper	15/12	+4	-3	+1 *
	Nebr./Wyo. Border	11/10	+2	-1	+1

B. Flow - Parameter Correlation.

Regression analysis of individual parameters versus flow was undertaken to determine the relationships, if any, between each constituent and the Index. Due to the dynamics of the underlying causes the associations are presumptive and should be thoroughly integrated with insights and experience. At the twenty-one (21) stations with sufficient flow and parameter coverage to permit development of a trend line for three or more parameters the following irregularities were observed with increasing flow:

1. On the Missouri River salinity seemed to intensify with increasing flow below Garrison Dam;

2. On the Red River of the North flow did not appear to be a dilutant for salinity at Fargo or Grand Forks;

3. Dissolved phosphorous intensified with increasing flow at the Green River, Utah station on the Green River, and also at the North Platte River at the Wyoming-Nebraska border station;

4. Dissolved nitrogen concentrations intensified with increasing flow at four (4) locations, namely, the North Platte River at Northgate; the Wind/Bighorn River below Boysen Reservoir, Wyoming, and at Kane, Wyoming; and also at Arvada on the Powder River;

5. Dissolved oxygen values intensified, i.e., were lower with higher flow at La Barge, Wyoming and at the Wyoming-Nebraska border station on the North Platte River.

Generally, total phosphorous intensified with increasing flow. Flow had little effect on BOD, flow was a dilutant on salinity; and at the few stations with data, also seemed to be a dilutant for fecal coliform.

Pollutant effects with increasing flow are summarized in Table 14.

Table 14

Individual Parameter
Pollutant Effect
With Increasing Flow

I = Intensify
D = Dilutant
NE = No Effect

		D.O.	BOD	Total Coli.	Fecal Coli.	N		P		Sal.
						Diss.	Tot.	Diss.	Tot.	
Missouri River	Ft. Benton, MT		I						I	D
	Garrison Dam, N.D.									I
Yellowstone River	Corwin Springs, MT								I	D
Clark Fork River	Deer Lodge, MT		NE						I	
	Above Missoula, MT								I	
	Thompson Falls, MT		NE						I	
Souris River	Verendrye, N.D.		NE		D		I		NE	
Red River of the North	Wahpeton, N.D.		I		D		I		I	
	Fargo, N.D.	NE	D		D				D	NE
	Grand Forks, N.D.							D		I
	Pembina, N.D.	NE	NE						I	
James River	Huron, S.D.					D				D
	Scotland, S.D.		NE						I	
Green River	LaBarge, WY	I				NE				D
	Green Dale, MT	NE								
	Jensen, Utah	NE						NE		D
	Green River	I					NE	I		D
North Platte River	Nort Hoate					I				NE
	WY - Nebr. Border	I	D		NE	D		I		D
Wind/Bighorn	BeBoysen Res.					I				D
	Kane					I				D
Powder	Arvada					I				D

APPENDIX 1

Data Rich Inventory Summary

Appendix 1

Data-Rich Directory

Selection Method for Stations in the Data-Rich Directory

There are over 180,000 stations in STORET; just over 18,000 of them are included in the Directory. The selected 10% were chosen according to the procedure described below.

Thirteen parameter groups were defined; each group consists from 1 to 53 related parameters. Associated with each group is a number or observations needed to "qualify" that group.

A parameter in a group is said to "qualify" in a particular year if and only if it has 2-4 or more observations in that year. At least one parameter must "quality" in a group for that group to qualify.

A year is said to "qualify" if four or more parameter groups qualify in that year.

A station is selected for the Directory if two or more years qualify for the station, or if 1972 or 1973 qualify.

The earliest qualifying year (after 1960), the latest qualifying year and the number of qualifying years are listed. Then, for the median qualifying year, each parameter group qualifying in that year is summarized. For each median-year qualifying group, both the number of qualifying parameters in the median-year and the median of the numbers of observations of these median-year qualifying parameters are provided.

Selected stations are listed in the Directory with location and parameter frequency information. Indications of the number of parameters measured and frequency of measurement are provided for each of the 13 groups participating in the selection process, as well as for flow and temperature.

In all cases, the median of a set is the smallest element which is greater than exactly half the elements in the set.

The groups and the parameters in each group are selected from "STORET System Water Quality File Parameter Classification", assembled by the Monitoring and Data Support Division, OWPS, Washington, D.C. in July, 1974.

A sample print-out of a Data-rich Directory is given in Figure 1. The key to reading the sample is attached.

Key to Reading the Directory

Heading

A. Assigned state number and corresponding EPA region number.

Colorado = 8
Montana = 30
N. Dak. = 38
S. Dak. = 46
Utah = 49
Wyoming = 56

B. Headings for the 15 parameter groups used to select stations for the Directory.

C. Directory edition number and date of edition.

Body

1. Assignment Code: A letter, A-I or R or S, indicating the reason the station was assigned to the state listed in A above. Table 1 explains the various codes.

2. State Number: The STORET state number.

3. Station Location Source Code: Indicates the source of the station location description in 4 below:

   Blank = STORET
   D = Station deleted since April 1974
   0 = On DC when STORET description is

4. Station location Description: A description, in words, of the station location.

5. Agency Code: The STORET agency number.

6. Station Number: The STORET station number assigned to the station by the controlling agency (see 5 above).

7. Station Type: The STORET station type codes. Table 2 explains the meanings of the codes.

8. Earliest Qualifying Year: The earliest year (after 1959) in which one or more parameter groups qualified for the station.

9. Latest Qualifying Year: The latest year (before 1974) in which one or more parameter groups qualified for the station.

10. Number of Qualifying Years: The number of qualifying years between the year in 8 and the year in 9, inclusive.

In 11 and 12 below, the median of N ordered elements is the middle element if N is odd, and element (N/2) +1 if N is even.

11. Number of Qualifying Parameters: By parameter group, the number of parameters in the group qualifying (in the median qualifying year). 11 is the first of the two codes appearing under each group heading. Table 3 explains the codes.

12. Median number of Observations: The median of the numbers of annual observations of the parameters in 11 above, by group. 12 is the second of the two codes appearing under each group heading. Table 3 explains the codes.

13 and 14. Line Number: A number used to match corresponding lines across the page break.

15. State and County Codes: The state and county numbers for the station as contained in the STORET Master Station File. The first two digits are the state number, the last 3 the county number.

16. Latitude: The latitude of the station's location, in degrees, minutes and seconds.

17. Longitude: The longitude of the station's location, degrees minutes and seconds.

18. Map Number: The Department of Interior, Office of Water Data Coordination (OWDC), station-location map number.

19. Submap Letter: The OWDC station-location map subunit number.

20. OWDC Number: A number assigned to the station by OWDC, and used in its "Catalog of Information on Water Data".

21. 1:250,000 Series Map Name: The name of the 1:250,000 - scale series USGS national topographic map on which the station falls, if the station is associated with valid geographical coordinates (see 16 and 17 above). These maps cover 1 degree of latitude and 2 degrees of longitude.

22. Row and Column Code: This code pinpoints the one of 128 equal 7.5' by 7.5' cells, covering the map in 21 above, that the station falls into.

23. Border Code: An "X" appears in this field if the station falls on a border between two cells described in 22 above.

24. 7.5' or 15' Series Map Name: The name of 1:24,000 - scale or 1:62,500 - scale USGS topographic map that covers the area of the cell described in 22 above. When a cell is covered by maps of both scales, only the 1:24,000 - scale map name is given.

25. 7.5' or 15' Map Series Code:

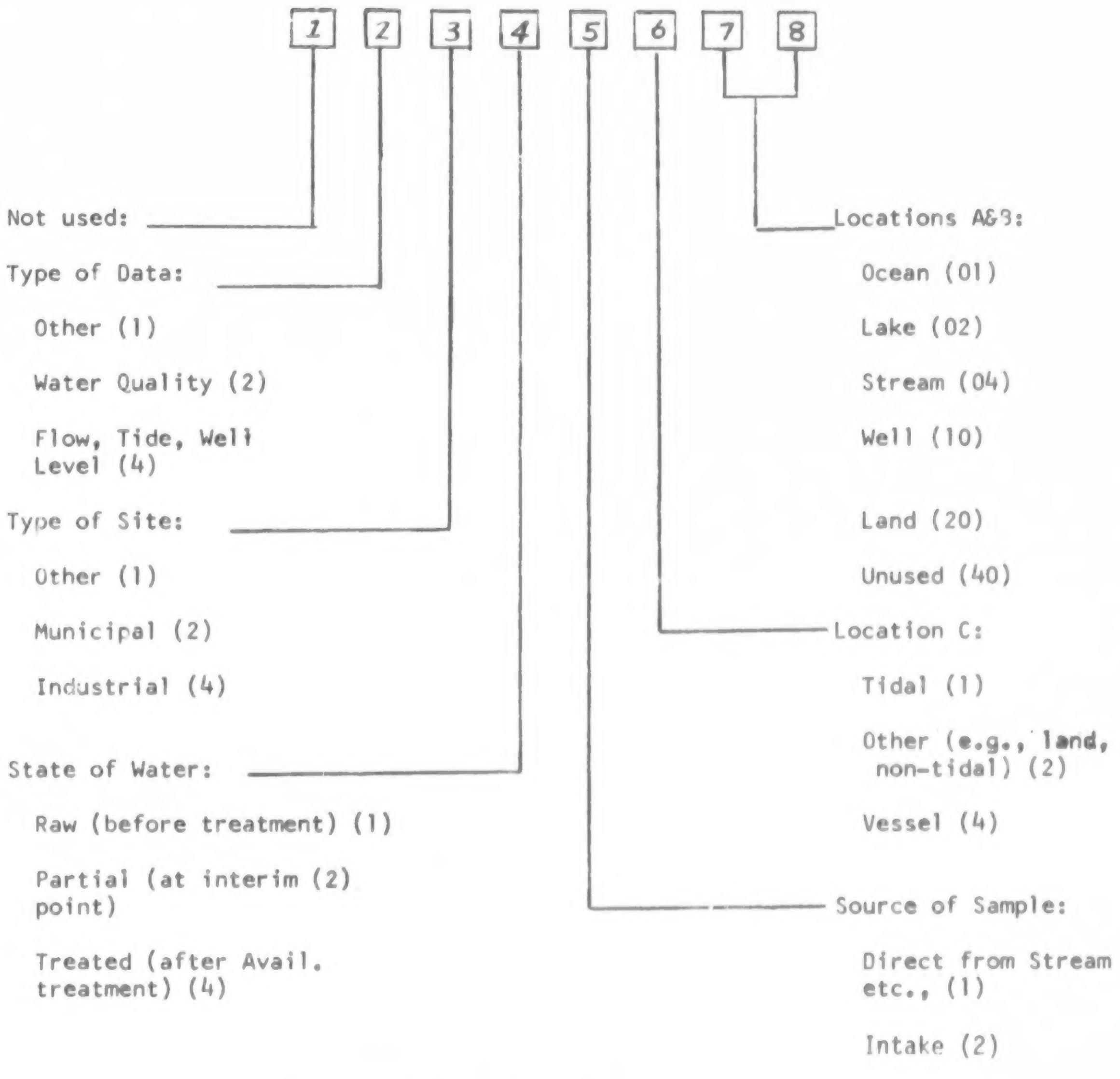
26. EPA Basin Codes: The EPA major and minor basin codes of basins found on the map in 24 above.

Table 1. Station-to-State Assignment Codes

The assignments are in hierarchical order. An appearance of a C implies the station could not be assigned by an A or a B.

Code	Reason for Assignment
A	The STORET agency number associated with the station is known to be also associated with the state indicated by the STORET state code. There is no associated OWDC entry.
B	The station's latitude and longitude in STORET fall within the maximum and minimum limits of latitude and longitude for the state indicated by the STORET state code. Ther associated OWDC entry.
C	The STORET agency number associated with the station is known to be also associated with the state indicated by the OWDC state code.
D	The STORET state number is the same as the OWDC state number.
E	The station's latitude and longitude in STORET fall within the maximum and minimum limits of latitude and longitude for the state indicated by the OWDC state code.
F	The station's latitude and longitude in OWDC fall within the maximum and minimum limits of latitude and longitude for the state indicated by the OWDC state code.
G	Code A with OWDC entry.
H	Code B with OWDC entry.
R	Station without OWDC entry could not be assigned to a state by above trials, nor by code I, but may be assigned to a region if its associated agency is assigned to a region.
S	Code R with OWDC entry.
I	Code R station reassigned (after other attempts as assignment are exhausted) to a state because the agency number associated with the station is known to be associated with a state.
J	Code S station reassigned similarly to the way Code R stations are reassigned to Code I.

TABLE 2 Key to Interpreting Station Type Codes



Not used:

Type of Data:

- Other (1)
- Water Quality (2)
- Flow, Tide, Well Level (4)

Type of Site:

- Other (1)
- Municipal (2)
- Industrial (4)

State of Water:

- Raw (before treatment) (1)
- Partial (at interim (2) point)
- Treated (after Avail. treatment) (4)

Locations A&B:

- Ocean (01)
- Lake (02)
- Stream (04)
- Well (10)
- Land (20)
- Unused (40)

Location C:

- Tidal (1)
- Other (e.g., land, non-tidal) (2)
- Vessel (4)

Source of Sample:

- Direct from Stream etc., (1)
- Intake (2)

Table 3

Numbers of Parameters
and Median Frequency Codes

Code	Median Parameter	Code	Median Parameter
1	1	J	19
2	2	K	20
3	3	L	21
4	4	M	22
5	5	N	23
6	6	O	24
7	7	P	25
8	8	Q	26
9	9	R	27
A	10	S	28
B	11	T	29
C	12	U	30
D	13	V	31
E	14	W	32
F	15	X	33
G	16	Y	35
H	17	Z	More than 34
I	18		

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Figure 1

```
SECT   597    \                 STORET SYSTEM DIRECTORY                                                     _______________ B _______________
1ST EDITION    \          FOR SELECTED STATIONS AND DATA                                          PH SO NI PH DI OX RA ME BA BI GE GE PE FL TE
SEPT 1974       C                   AS OF APRIL 1974                                                 YS LI TR OS SS YG DI TA CT OL NE NE ST OW MP
REGION  9      /                                                                                     IC DS OG PH OL EN OL LS ER OG RA RA IC    ER
                                                                                                     AL    EN OR VE  D OG    IO IC L  L  ID    AT
STATE 30  A                                                                                                   US D  EM IC    LO AL OR IN ES    UR
                                                                                                                 OX AN AL    GI    GA OR       E
                                                                                                                 YG D        CA    NI GA
1  2  3 _________________ 4 _________________      5          6            7        8  9  10             EN          L     C  NI
A  ST C  S T A T I O N   L O C A T I O N        AGENCY     STATION       TYPE      FA LA NO                                       C
                                                                                           11 12
R  30    LAKE KOOCANUSA BL DINKHAM CREEK,     112WRD     12301600      77777777  72 73  2  3Z    8Z 34    17    CA 17       3E C2    1Z
H  30    KOOTENAI R. AB ROXFORD, MONT.        112WRD     12301500      06111204  67 72  6  4% 1R 6C 5C 1A       S3          BC    1M 1F
R  30    LAKE KOOCANUSA AT TENMILE CREEK,     112WRD     12301930      77777777  72 73  2  2W    8Z 38    18    CD 1A       3C       1Z
R  30    KOOTENAI RIVER AT LIBBY, MONT.       1115CC05C  293001        02111204  68 69  2  5C 16 77 47 1C 1E    R6 34    17          16 2D
H  30    KOOTENAI RIVER AT LIBBY, MONT.       112WRD     12303000      02111204  68 73  6  53    77 58 1C 1C    L2 2C    1C 2C       1C 17
H  30    KOOTENAI RIVER BL LIBBY DAM, NEA     112WRD     12301933      06111204  67 73  7  4A 1C 6C 5C 1A       S3          8C       1C 13
C  30    LAKE KOOCANUSA AT FOOTBAY AT LIB     112WRD     12301919      77777777  72 73  2  20    7Z 39    16    CF 18       3E D4    1Z
H  30    FISHER RIVER NEAR LIBBY, MT.         112WRD     12302055      06111204  67 73  7  4A 13 6P 48 1A       C4          AE    1M 1A
H  30    FLATHEAD RIVER AT COLUMBIA FALLS     112WRD     12363000      02111204  63 67  5  3T 1T 3K             ST          9T    1V
H  30    WOLF CREEK NEAR LIBBY, MONT.         112WRD     12301999      02111204  67 70  4  4Z 1Z 2Z    14       PZ          8Z    1Z 1S
H  30    FISHER RIVER ABOVE WOLF CREEK, N     112WRD     12301990      06111204  67 70  4  4C 1C 2C    1E       AC          8C    1Z 1M
H  30    FLATHEAD RIVER NEAR BIGFORK, MON     112WRD     12369000      02111204  69 71  3  5A 18 63 49 1A 1E    L9 2A    1C 4S       1C 1E
R  30    MISSOURI R NEAR ZORTMAN              121MBTCF   293007        77777777  68 72  4  45 15 25 15 15       55          45          15
H  30    YELLOWSTONE RIVER NEAR MILES CIT     112WRD     06250120      02111204  69 73  6  27    1C 39          AC          HC    1X 19
H  30    POWDER RIVER AT MILES CITY, MT.      112WRD     06326500      06111204  62 73 11  27 1T                P3          6T    1T
R  30    YELLOWSTONE R. AT HUNTLEY, MONT.     112WRD     06217500      77777777  72 73  2  36 18 45 45 16 1E    4P 26       58    1R 17
R  30    MILK RIVER AT EASTERN CROSSING O     112WRD     06135000      77777777  73 73  1  25    15 25          C5          85    15 1F
H  30    MARIAS RIVER NEAR CHESTER, MT.       112WRD     06101500      06111204  64 72  9  7H 11 1F             SI          8I    1M
H  30    FLATHEAD LAKE AT POLSON, MONT.       112WRD     12371550      02111204  69 71  3  5A 18 69 49 1A 1E    KU 2A    1C 4S       1C 1F
H  30    CLARK FORK AT THOMPSON FALLS, MT     112WRD     12391000      02111204  65 73  5  5C    43 47 1C 1C    U4 2C    18 38       1C 17
R  30    CLARK FORK AT PLAINS MONTANA         1115CC05C  293002        02111204  68 69  2  47    47 37 17       E7 16    17 67          17
H  30    CLARK FORK NEAR PLAINS, MT.          112WRD     12389000      02111204  63 70  3  50 16 76 36 1C 1E    R5 26    18 6C       1C 1J
H  30    FLATHEAD RIVER AT PERMA, MT.         112WRD     12388700      77777777  71 73  3  5A 15 25 35 14 1A    L2 2A       57       19 1L
H  30    MISSOURI R BL CANYON FERRY DAM N     112WRD     06058502      06111204  67 73  7  3M 1M 1M             SM          8M       1P 15
R  30    MISSOURI R BL TOWNSEND MT            21MTHOWC   304110        02111204  72 72  1  26 16 16 15 16 15    66          56       16 16
H  30    MISSOURI R AT TOSTON MONT            112WRD     06054500      77777777  72 73  2  45 15 38 19 16 15    R3 36       89       19 1D
H  30    MISSOURI RIVER NEAR WOLF POINT,      112WRD     06177000      06111204  62 73  9  3R 18                S8          88       1D
H  30    MISSOURI RIVER NEAR CULBERTSON,      112WRD     06185500      06111204  65 73  8  56 1C 36 38 15 15    93 14    16 6C 92 1V 1J
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SECT  5B3                              STORET SYSTEM DIRECTORY
1ST EDITION                        FOR SELECTED STATIONS AND DATA
SEPT 1974                               AS OF APRIL 1974
REGION  8

STATE 30


14   15       16           17       18 19   20            21             USGS MAP NAMES   21            25          26
LN STORD LATITUDE LONGITUDE MA SU CHECK#   1:250,000 SERIES    P C R  7.5' OR 15' SERIES    EPA MAJOR AND MINOR BASINS
                                                               22 23
 1 30053 48 45 27 115 15 58               KALISPELL             F 6   WEBB MTN          7.5 PN01
 2 30001 48 52 28 115 13 37 76  D 67061 KALISPELL             B 7   BEARTRAP MTN      7.5 PN01
 3 30053 48 35  6 115 13 52               KALISPELL             D 7   VOLCOUR           7.5 PN01
 4 30001 48 23 52 115 32 48               KALISPELL             F 4   LIBBY             7.5 PN01
 5 30053 48 24  3 115 33  8 76  D 67001 KALISPELL             F 4   LIBBY             7.5 PN01
 6 30053 48 24  3 115 19 11 76  D 67060 KALISPELL             E 6   ALEXANDER MTN     7.5 PN01
 7 30053 48 24 43 115 19 33               KALISPELL             F 6   ALEXANDER MTN     7.5 PN01
 8 30053 48 21 20 115 18 50 76  C 67059 KALISPELL             F 6   TONY PEAK         7.5 PN01
 9 30029 48 21 43 114 11  2 76  L 51138 KALISPELL             F15   COLUMBIA FLLS S 7.5 PN02
10 30053 48 14  1 115 17  2 76  C 67065 KALISPELL             G 6   FISHER MTN        7.5 PN01
11 30053 48 12 60 115 16 20 76  C 63058 KALISPELL             G 6   FISHER MTN        7.5 PN01
12 30029 48  5 33 114  6 50 76  L 67009 KALISPELL             H16   BIG FORK          7.5 PN02
13 [illegible] 47 43 60 109 55 65               LEWISTOWN             C 9   BAKER MONUMENT    7.5 MR01
14 30017 46 23 51 105 53 36 42  K 66999 MILES CITY            F 1   BIG HILL          7.5 MR02
15 30017 46 21 30 105 46 24 42  C 51126 MILES CITY            F 2   PADDY FAY CREEK   7.5 MR02
16 30011 46 54 15 108 19  1               ROUNDUP               A14                         MR01
17 30041 48 55  5 110 28 15               SHELBY                A13                         MR01
18 30051 48 19  0 111  5 29 41  O 51107 SHELBY                F 8   TIBER DAM         7.5 MR01
19 30047 47 41 40 114  9 60 76  L 67010 WALLACE               C15   POLSON            7.5 PN02
20 30089 47 36 17 115 22 30 76  N 67012 WALLACE               F 5   THOMPSON FALLS     15 PN02
21 [illegible] 47 27 15 114 53 36               WALLACE               E 9   PLAINS             15 PN02
22 [illegible] 47 25 47 114 51 18 76  N 67011 WALLACE               F10   PLAINS             15 PN02
23 30029 47 22  1 114 35  3 76  L 72675 WALLACE               F12   PERMA              15 PN02
24 30049 46 35 58 111 43 29 41  I 63062 WHITE SULPHUR SPRING  C 3
25 30070 46 19 60 111 31 40               WHITE SULPHUR SPRING  F 4
26 30001 46  8 46 111 25 10               WHITE SULPHUR SPRING  G 5
27 30001 48  3 57 105 32 12 40  S 51114 WOLF POINT            H 4   WOLF POINT         15 MR03
28 30085 48  7 24 104 28 30 40  S 51115 WOLF POINT            H13   THREE BUTTES      7.5 MR03
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APPENDIX 2

Water Quality Index
Violations/Observations Summary

Appendix 2

Violations/Observations Summary

State/ Watercourse	Location	1st Period										2nd Period									
		ORB		Bac-T		N		P		Phys/Aeth		ORB		Bac-T		N		P		Phys/Aeth	
		Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.
Colorado																					
S. Platte River	Fairplay to Exposition Avenue	38	323	44	553	17	35	68	87	29	546	6	341	10	532	20	73	155	197	35	646
	Exposition Avenue to Stateline	790	3125	291	695	177	195	307	311	572	1639	1118	4132	449	994	565	574	799	805	1784	4274
Colorado River	Head to Grand Valley	9	159	16	143	7	124	57	143	22	586	2	200	0	188	2	136	62	134	34	601
	Grand Valley to Stateline	6	134	56	145	59	91	40	95	133	383	0	128	15	141	31	81	38	76	103	343
Arkansas River	Head to Canon City	11	104	13	140	6	73	36	69	2	288	2	74	1	85	0	51	25	49	3	253
	Canon City to Stateline	10	313	102	370	142	188	132	144	369	1197	3	319	42	314	129	183	125	181	226	732
Rio Grande River		9	120	7	120	2	53	45	51	14	342	4	105	3	104	0	47	42	43	12	237
Green River		0	4	0	6	0	5	1	4	0	16	0	15	0	22	4	9	3	8	3	37
North Platte River		6	31	2	45	2	17	8	16	3	153	2	28	1	34	0	22	7	13	4	130
Montana																					
Missouri River	Head to Sun River	0	7	1	2	1	4	0	3	2	11	0	42	2	35	7	21	16	21	6	111
	Sun River to Rainbow Dam	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 2

State/ Watercourse	Location	1st Period										2nd Period									
		ORB		Bac-T		N		P		Phys/Aeth.		ORB		Bac-T		N		P		Phys/Aeth.	
		Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.
Montana																					
Missouri River	Rainbow Dam to Ft. Peck Dam	0	72	0	35	0	45	38	40	7	142	0	53	1	31	0	27	16	17	1	96
	Ft. Peck Dam to the Milk River	0	1467	0	0	0	27	6	17	0	1500	1	1649	0	0	0	25	0	13	7	1698
	Milk River to the Stateline	0	35	1	7	0	62	36	57	10	275	0	25	0	29	1	40	14	40	0	212
Bighorn River	Wyoming to Williams Coulee	0	23	0	12	1	71	15	34	66	280	0	0	0	0	2	40	13	61	28	158
	Williams Coulee to Yellowstone River	0	47	6	22	2	49	15	37	60	161	0	45	3	30	0	36	13	36	49	174
Yellowstone River	Yellowstone Park to the Laurel WTP	0	141	1	20	1	83	33	38	5	326	0	32	0	28	2	62	29	33	2	271
	Laurel WTP to the Billings WTP	0	65	6	33	0	33	25	33	3	110	0	22	1	11	0	10	8	10	0	37
	Billings WTP to the Stateline	0	40	6	21	3	158	63	123	168	926	0	91	8	87	25	124	61	121	120	826
Clark Fork River	Warm Springs to Cottonwood Creek	0	22	3	20	0	4	4	4	24	45	0	45	8	44	1	11	9	10	46	85
	Cottonwood Creek to Little Blackfoot River	0	46	13	42	7	24	21	23	46	110	0	0	0	0	0	0	0	0	0	0
	Little Blackfoot River to the Stateline	0	191	10	168	0	91	70	92	17	463	0	42	0	42	0	10	8	11	1	97
Powder River		1	65	10	33	6	30	19	30	59	105	1	25	0	12	3	22	12	14	32	73

Appendix 2

State/ Watercourse	Location	1st Period ORB Viol.	Obs.	Bac-T Viol.	Obs.	N Viol.	Obs.	P Viol.	Obs.	Phys/Aeth. Viol.	Obs.	2nd Period ORB Viol.	Obs.	Bac-T Viol.	Obs.	N Viol.	Obs.	P Viol.	Obs.	Phys/Aeth. Viol.	Obs.
North Dakota																					
Missouri River		0	3409	0	15	0	53	24	53	44	3667	0	1837	1	64	2	54	19	48	3	2026
Souris River		19	308	40	195	6	87	89	100	255	723	27	298	48	269	5	90	166	181	282	728
Red River of The North		37	879	299	638	56	333	365	380	329	2307	9	917	285	746	57	336	448	468	296	2280
James River		8	230	38	143	6	40	74	75	160	394	8	164	55	147	4	33	93	93	125	278
South Dakota																					
Missouri River	North Dakota to Big Bend Dam	0	3299	0	0	0	32	9	37	966	3361	0	1640	0	28	4	53	23	52	804	1757
	Big Bend Dam to Stateline	1	2057	0	103	1	54	34	59	851	5353	1	1929	0	127	1	54	21	39	521	1897
	Cheyenne River to Angostura Dam	1	29	1	14	6	18	15	22	59	72	0	35	5	26	3	28	22	27	71	105
	Angostura Dam to Fall River	0	0	0	0	5	41	27	34	47	130	0	0	0	0	3	34	25	36	34	102
	Fall River to Yellowstone River	1	31	0	10	37	78	38	54	93	228	0	17	0	0	40	66	46	66	80	223
Big Sioux River	Head to Sioux Falls	0	0	0	1	38	55	42	43	56	202	0	28	2	16	21	42	46	47	55	159
	Sious Falls to Klondike Dam	0	3	1	1	19	33	34	35	26	71	0	28	12	14	13	34	34	34	53	124
	Klondike Dam to Stateline	0	0	0	0	0	0	0	0	0	0	3	28	9	28	6	11	11	11	23	47
James River	To Diversion Dam	2	26	0	25	21	60	25	26	50	206	3	24	0	23	30	55	33	35	50	198

Appendix 2

State/ Watercourse	Location	1st Period										2nd Period									
		ORB		Bac-T		N		P		Phys/Aeth.		ORB		Bac-T		N		P			
		Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.
South Dakota																					
James River	Diversion Dam to Huron	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Huron to the Missouri River	6	70	6	58	19	67	64	64	100	224	3	93	2	41	47	127	105	105	195	498
Utah																					
Jordan River	Utah Lake to Utah County Line	2	23	2	19	0	0	0	0	0	1	8	30	0	20	0	11	7	8	16	84
	Utah County Line to Great Salt Lake	303	438	312	409	58	61	58	62	11	354	231	537	265	440	75	86	83	86	173	480
Colorado River		5	68	25	70	27	29	10	31	43	124	25	97	29	92	45	62	23	54	55	214
Bear River	Head to Wyoming Stateline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Utah to Wyoming Stateline	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Idaho Stateline to Great Salt Lake	11	78	25	78	9	14	11	13	26	88	4	50	13	85	5	15	7	2	17	79
Weber River	Head to Highway 40	14	49	23	69	10	18	10	29	7	137	6	61	32	90	3	31	9	30	4	148
	Highway 40 to Great Salt Lake	0	0	0	0	8	13	13	13	3	65	0	1	0	0	23	47	46	47	8	232
Green River	Flaming Gorge to Colorado Stateline	0	22	2	29	0	0	0	0	0	0	0	19	2	30	5	5	1	5	3	35
	Colorado Stateline to Colorado River	0	73	5	67	26	53	24	61	54	287	1	53	10	69	24	48	19	44	29	214

Appendix 2

State/ Watercourse	Location	1st Period ORB		Bac-T		N		P		Phys/Aeth.		2nd Period ORB		Bac-T		N		P		Phys/Aeth.	
		Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.	Viol.	Obs.
Wyoming																					
North Platte River		0	120	18	44	43	98	36	60	101	1051	0	117	21	70	43	150	19	41	67	983
Wind - Bighorn River		0	32	0	0	1	50	5	17	91	777	0	33	0	23	3	79	2	11	50	611
Green River		0	60	0	0	0	43	0	1	13	774	0	69	0	23	2	75	0	9	7	602
Powder River		0	0	0	0	0	0	0	0	130	276	2	22	6	16	0	24	0	6	70	207

APPENDIX 3

Station by Station Breakdown of Water Quality Index

Colorado
STATE

Watercourse and segment description	State Classification (uses)*	1983 goal projection	Segment Index 1st	Segment Index 2nd
South Platte River Headwaters to Exposition Avenue	B-1 (UM-CF)	Yes	13	5

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21CODBWC - 001109	South Fork below Cheesman Reservoir	NR	NR	ID	ID	-	-	5.6
21CODBWC - 001112	South Fork above North Fork	NR	NR	ID	ID	-	-	5.6
21CODBWC - 001202	North Fork near Bailey	NR	NR	ID	ID	-	-	9.8
21COL001 - 000025	At South Platte	3	2	ID	ID	-33	10	41.3
21CODBWC - 001301	At Denver Water Board Intake	NR	NR	ID	ID	-	ID	41.3
21CO1001 - 000023	Above Littleton	3	3	ID	ID	0	ID	13.6
21CODHDP - 1513	At Bowles Avenue	6	2	ID	ID	-67	ID	13.6
21CODHDP - 1091	At Dartmouth Avenue below Littleton	13	7	ID	ID	-46	ID	13.6

* See Table 11 for symbols

NR = Not Rateable
ND = No Data
ID = Insufficient Data
NA = Not Available

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
South Platte River Exposition Avenue to the Nebraska Border	B-2 (UM-WF)	Doubtful - Upper Reach	43	47

AGENCY-STATION	LOCATION	WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
		1st	2nd	1st	2nd	WQI	MEAN FLOW	-
21CODHPD - 0699	Alameda Avenue	17	19	ID	ID	+12	-	13.6
21CODHDP - 0305	19th Street	20	22	ID	ID	+10	-	27.6
21CODHDP - 0001	Franklin Street	26	26	ID	ID	0	-	27.6
21COMETR - 000002	60th Avenue	43	37	ID	ID	-14	-	27.6
21COMETR - 000004	88th Avenue	51	46	ID	ID	-10	-	NA
21COMETR - 000010	124th Avenue	56	60	ID	ID	-19	-	NA
21COL001 - 000023	Henderson	54	44	648	519	-23	-20	13.5
112WRD - 06720500	Henderson	55	56	648	519	-2	-20	13.5
21COL007 - 000022	Kersey	47	41	ID	ID	-13	-	49.2
112WRD - 06754000	Kersey	NR	ND	ID	ID	-	-	49.2
112WRD - 06758500	Weldona	NR	NR	547	997	-	+80	52.2
21COL001 - 000021	Balzac	24	15	ID	ID	37	-	6.3

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
South Platte River Exposition Avenue to the Nebraska Border	B-2 (UM-WF)	Doubtful - Upper Reach	43	47

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06760000	Balzac	NR	ND	NR	ID	-	-	6.3
21COL007 - 000128	Sterling	NR	15	ID	ID	-	-	NA
21COL007 - 000020	Julesburg	35	12	610	798	-66	+30	8.8
112WRD - 06764000	Julesburg	NR	8	610	798	-	+30	8.8
112WRD - 06764200	Julesburg	NR	NR	610	798	-	-	8.8
11 10NET - 070092	Julesburg	NR	NR	610	798	-	-	8.8

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Colorado River Headwaters to Grand Valley	B-1 (UM-WF)	Yes	8	3

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 09019000	Below Lake Granby	NR	1	64	57	-	-11	8.3
112WRD - 09034500	Hot Sulphur Springs	NR	NR	322	271	-	-16	44.8
21COL007 - 000045	Hot Sulphur Springs	6	2	322	271	-67	-16	44.9
112WRD - 09070500	Dotsero	NR	NR	ID	ID	-	-	501.0
21COL007 - 000046	Dotsero	5	2	ID	ID	-60	-	501.0
112WRD - 09071100	Glenwood Springs	NR	NR	ID	ID	-	-	NA
21COL001 - 000047	Newcastle	16	4	ID	ID	-75	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Colorado River from Grand Valley to Stateline	B-2 (UM-WF)	Probable	24	11

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
12WRD - 09095500	Cameo	NR	NR	4288	4112	-	-4	945.6
1COL001 - 000048	Cameo	11	4	4288	4112	-64	-4	945.6
1COL001 - 000049	Fruita	27	16	ID	ID	-31	-	NA
1COL001 - 000050	Loma	28	11	ID	ID	-61	-	NA
12WRD - 09163500	Colorado-Utah Border	NR	NR	6753	ID	-	-	1356.7

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
Arkansas River Headwaters to Canon City	B-1 (UM-CF)	Yes	6	2

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21COL001 - 000009	Leadville	7	3	ID	ID	-67	-	NA
21COL001 - 000008	Salida	6	2	ID	ID	-67	-	179.8
21COL001 - 000007	Above Canon City	9	2	703	724	-78	+3	121.8
112WRD - 07096000	Above Canon City	NR	NR	703	724	-	+3	121.8

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
Arkansas River Canon City to the Kansas Border	B-2 (UM-WF)	Doubtful Middle & Lower Reach	20	13

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 07099200	Portland	NR	NR	826	826	-	0	NA
112WRD - 07099400	Above Pueblo	NR	NR	826	820	-	0	44.2
21COL001 - 000006	Above Pueblo	9	4	ID	ID	-56	-	44.2
11388RECD - 070995	Above Pueblo	NR	NR	NR	NR	-	-	44.2
21COL001 - 000005	Nepesta	26	16	ID	ID	-35	-	64.7
21COL001 - 000090	Catlin Canal	15	16	ID	ID	+7	-	NA
21COL001 - 000004	La Junta	30	16	ID	ID	+7	-	4.8
112WRD - 07122000	La Junta	NR	NR	ID	ID	-	-	4.8
21COL001 - 000003	Las Animas	25	15	ID	ID	-37	-	4.4
112WRD - 07130500	Below John Martin Reservoir	NR	NR	239	351	-	+47	1.5
112WRD - 07133000	Lamar	12	12	76	104	0	+37	0.6
21COL001 - 000002	Lamar	15	16	76	104	+7	+37	0.6

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
Arkansas River Canon City to the Kansas Border	B-2 (UM-WF)	Doubtful Middle & Lower Reach	20	13

AGENCY-STATION	LOCATION	WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
		1st	2nd	1st	2nd	WQI	MEAN FLOW	
21COL001 - 000001	Kansas Border	24	13	164	132	-46	-20	1.0

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
Rio Grande River Headwaters to the New Mexico Border	B-1 (UM-CF)	Yes, If classification changed	8	5

AGENCY-STATION	LOCATION	WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
		1st	2nd	1st	2nd	WQI	MEAN FLOW	-
21COGF8P - CRD003	Above Willow Creek	NR	NR	ID	ID	-	-	NA
21COGF8P - CRD004	Wasson Bridge	NR	NR	ID	ID	-	-	NA
21COL001 - 000019	Alamosa	7	3	ID	ID	-43	-	9.3
21COL001 - 000018	Manassa	9	7	ID	ID	-22	-	6.5
112WRD - 08251500	Lobatos	4	4	476	402	0	-16	6.5

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
North Platte River Headwaters to Wyoming Border	B-1 (UM-CF)	Probable	8	5

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
21COL007 - 000037	Cowdrey	7	4	ID	ID	-43	-	NA
112WRD - 06620000	Northgate	NR	NR	654	467	-	-29	33.5

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
Green River Colorado Segment	B-1 (UM-CF)	Probable	NR	4

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
21COL001 - 000112	Colorado/Utah Border	NR	4	4706	4112	-	-13	407.5

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index, 1st	Segment Index, 2nd
Colorado Lakes Horsetooth & Carter Reservoir	A-1 (UM-CF) A-1 (UM-CF)	Yes Yes	2/3	2/3

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
112WRD - 06737500	Horsetooth Reservoir	2	3	NA	NA	+50	-	NA
112WRD - 06742500	Carter Reservoir	2	3	NA	NA	+50	-	NA

Watercourse and segment description	State Classification (uses)	1983 goal projection			Segment Index 1st 2nd
Missouri River Headwaters to Sun River	B,D1 (UM-CF)	Probable			NR 6
		WQI	MEAN FLOW (cfs)	PERCENT CHANGE	7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st 2nd	1st 2nd	WQI MEAN FLOW	
112WRD - 06054500	Toston	ND 5	ID 4420	- -	1272.4
21MTHDWD - 304110	Below Townsend	NR NR	10 4420	- -	1272.4
Missouri River Sun River to Rainbow Dam	B, D2 (UM-CF incl. Salmonid marginal)	Questionable			ND ND
		WQI	MEAN FLOW (cfs)	PERCENT CHANGE	7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st 2nd	1st 2nd	WQI MEAN FLOW	
No Stations					
Missouri River Rainbow Dam to Fort Peck Dam	B, D3 (UM-CF)	Probable			3 2
		WQI	MEAN FLOW (cfs)	PERCENT CHANGE	7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st 2nd	1st 2nd	WQI MEAN FLOW	
112WRD - 06090800	Ft. Benton	3 3	9706 8220	0 -5	2163.3
121MBRCE - 293007	Zortman	NR NR	ID 12387	- -	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st 2nd
Missouri River Ft. Peck Dam to Milk River	B, D2 (UM-CF)	Probable	NR NR

AGENCY-STATION	LOCATION	WQI 1st 2nd	MEAN FLOW (cfs) 1st 2nd	PERCENT CHANGE WQI MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
121MBRCE - 293003	Below Fork Peck Dam	NR NR	ID ID	- -	653.9

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st 2nd
Missouri River Milk River to the North Dakota Border	B, D3 (WM-CF)	Probable	4 2

AGENCY-STATION	LOCATION	WQI 1st 2nd	MEAN FLOW (cfs) 1st 2nd	PERCENT CHANGE WQI MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06177000	Wolf Point	NR NR	12074 10315	- -15	930.5
112WRD - 06195500	Culbertson	5 2	12634 9694	-60 -23	2992.2

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Yellowstone River Yellowstone Park to the Laurel WTP	B, D1 (UM-CF)	Yes	3	2

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06191500	Corwin Springs	5	3	4706	ID	-75	-	520.1
112WRD - 06192500	Livingstone	NR	NR	5879	4317	-	-27	785.0

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Yellowstone River Laurel WTP to the Billings WTP	B, D2 (UM-CF)	Yes	5	3

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06214100	Below Laurel	5	3	8673	7941	-40	-9	1027.8

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Yellowstone River Billings WTP to the North Dakota Border	B, D3 (UM-CF)	Questionable	8	8

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06214500	Billings	NR	NR	8673	7941	-	-9	1027.8
112WRD - 06217500	Huntley	NR	12	ID	ID	-	-	1027.8
112WRD - 06218000	Custer	8	ND	ID	ID	-	-	NA
112WRD - 06296120	Miles City	NR	3	ID	ID	-	-	1660.4
121MBRCE - 293000	Sidney	NR	ND	ID	ID	-	-	1358.4
112WRD - 06329500	Sidney	8	7	ID	ID	-12	-	1358.4
110NET - 290055	Sidney	NR	NR	ID	ID	-	-	1358.4

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Bighorn River Wyoming Border to Williams Coulee (below) Hardin	B, D1 (UM-CF)	Probable	4	NR

		WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st	2nd	1st	2nd	WQI	MEAN FLOW	-
112WRD - 06287000	St. Xavier	4	NR	3851	4262	-	+11	550.4

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Bighorn River Williams Coulee (below Hardin) to the Yellowstone River	B, D2 (UM-CF)	Probable	11	6

		WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st	2nd	1st	2nd	WQI	MEAN FLOW	-
112WRD - 06188500	Hardin	11	8	3851	4262	-33	+11	NA
11ONET - 29014	Hardin	NR	ND	3851	4262	-	+11	NA
112WRD - 06294700	Bighorn	NR	NR	4773	4259	-	-11	597.2

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st / 2nd
Clark Fork River Warm Springs Creek to Cottonwood Creek	C, D2 (LM-CF)	Questionable	9 13

AGENCY-STATION	LOCATION	WQI 1st / 2nd	MEAN FLOW (cfs) 1st / 2nd	PERCENT CHANGE WQI / MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
					-
112 WRD - 12323800	Galen	9 13	ID ID	+44 -	NA

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st / 2nd
Clark Fork River Cottonwood Creek to the Little Blackfoot River	C, D1 (LM-CF)	Questionable	16 NR

AGENCY-STATION	LOCATION	WQI 1st / 2nd	MEAN FLOW (cfs) 1st / 2nd	PERCENT CHANGE WQI / MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
					-
112WRD - 12324200	Deer Lodge	16 ND	364 ID	- -	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Clark Fork River Little Blackfoot River to the Idaho Border	B, D1 (UM-CF)	Yes	4	2

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
1119C050 - 293005	Above Missoula	NR	ND	3601	ID	-	-	555.9
112WRD - 12340500	Above Missoula	5	ND	3601	ID	-	-	555.9
1119C050 - 293003	Near Alberton	NR	ND	ID	ID	-	-	NA
1119C050 - 293002	At Plains	NR	ND	ID	ID	-	-	4303.2
112WRD - 12389000	Near Plains	2	ND	ID	ID	-	-	4303.2
112WRD - 12391000	Thompson Falls	2	2	24558	21495	0	-13	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st / 2nd
Powder River Wyoming Border to the Yellowstone River	B, D3 (UM-CF)	Probable	18 / 9

AGENCY-STATION	LOCATION	WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
		1st	2nd	1st	2nd	WQI	MEAN FLOW	-
112WRD - 06324500	Moorhead	18	9	645	ID	-47	-	3.60

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st / 2nd
Montana Lakes Flathead and Koocansa Lakes	B, D1 (UM-CF) A (open) D1 (UM-CF)	Yes	ND/3 2/NR

AGENCY-STATION	LOCATION	WQI		MEAN FLOW (cfs)		PERCENT CHANGE		7 D. 10 YR. LOW FLOW (cfs)
		1st	2nd	1st	2nd	WQI	MEAN FLOW	-
112WRD - 12371550	Flathead Lake at Polson	2	ND	NA	ND	-	-	NA
112WRD - 12300110	Koocanusa Lake at International	ND	3	NA	NA	-	-	NA
112WRD - 12301600	Koocanusa Lake at Pinkham Creek	ND	3	NA	NA	-	-	NA
112WRD - 12301830	Koocanusa Lake at Tenmile Creek	ND	2	NA	NA	-	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Missouri River Border to Border	I (UM-Native Fish)	Yes	2	1

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
121MBRCE - 370005	Williston	NR	ND	12634	9694	-	-15	2992.2
112WRD - 06330000	Williston	NR	NR	12634	9694	-	-15	2992.2
121MBRCE - 370004	Newtown	NR	ND	NR	ID	-	-	NA
121MBRCE - 370002	Below Garrison Dam	NR	NR	26640	24620	-	-8	NA
112WRD - 06338490	Below Garrison Dam	NR	NR	26640	24620	-	-8	NA
121MBRCE - 370001	Washburn	NR	ND	ID	ID	-	-	NA
111ONEL - 370033	Bismarck	NR	NR	ID	ID	-	-	3088.8
21NDHDWQ - 380028	Bismarck	ND	NR	ID	ID	-	-	3088.8

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Souris River Canada to Canada	IA (LM-UM)	No	18	19

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 05116000	Foxholm	NR	7	ID	112	-	-	0.03
21NDHDWQ - 05117500	Minot	NR	NR	340	218	-	-37	0.12
112WRD - 05117500	Minot	16	16	340	218	0	-37	0.12
112WRD - 05120000	Verendrye	26	23	ID	187	-12	-	0.70
21NDHDWQ - 380018	Towner	15	16	ID	ID	+7	-	1.20
21NDHDWQ - 380019	Westhope	8	11	ID	ID	+38	-	0.08
112WRD - 05124000	Westhope	7	18	ID	ID	+157	-	0.08

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Red River of the North Wahpeton to the Canadian Border	I (UM-Native Fish)	Questionable	18	12

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21NDHDWQ - 380001	Above Wahpeton	10	11	ID	765	+10	-	NA
21MINN - RRRR547	Brechenridge	11	15	ID	765	+36	-	NA
112WRD - 05051500	Below Wahpeton	6	5	ID	765	-17	-	27.9
112WRD - 05054000	Fargo	NR	NR	601	786	NR	+30	16.6
112WRD - 05054020	Fargo	25	12	601	786	-52	+30	16.6
21MINN - RRRR452	Fargo	9	10	601	786	10	+30	16.6
21NDHDWQ - 380002	Fargo	17	10	601	786	-41	+30	16.6
21MINN - RRRR403	Below Fargo	29	16	ID	ID	-45	-	NA
21NDHDWQ - 380003	Grand Forks	11	7	3653	3561	-36	-2	49.0
21NDGRFK - 000002	Grand Forks	NR	NR	3653	3561	-	-2	392.4
21MINN - RRRR296	Grand Forks	22	11	3653	3561	-50	-23	392.4
112WRD - 05071500	Grand Forks	NR	ND	3653	3561	-	-2	392.4

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Red River of the North Wahpeton to the Canadian Border	I (UM-Native Fish)	Questionable	18	12

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
111ONET - 370069	Grand Forks	NR	ND	3653	3561	-	-2	392.4
112WRD - 05082500	Grand Forks	NR	NR	3653	3561	-	-2	392.4
21MINN - RRRR274	Oslo	18	4	ID	ID	-28	-	NA
112WRD - 05083500	Oslo	ND	15	ID	ID	-	-	NA
21NDHDWQ - 380004	Drayton	9	9	12140	8035	0	-34	235.4
21NDHDWQ - 380005	Pembina	8	7	ID	ID	-14	-	45.7
21MINN - RRRR155	Pembina	14	12	ID	ID	-14	-	45.7
112WRD - 05102440	Pembina	7	5	ID	ID	-29	-	45.7
51MANPB - 000001	Emerson - Canada	11	11	ID	ID	0	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
James River Headwaters to South Dakota Border	IA (LM-Native Fish)	No	9	23

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
21NDHDWQ - 380014	Edmunds	13	22	ID	ID	+69	-	NA
21NDHDWQ - 380013	Jamestown	15	12	ID	ID	-20	-	0.51
112WRD - 06470500	La Moure	NR	NR	ID	65	-	-	2.3
21NDHDWQ - 380012	La Moure	11	12	ID	65	+7		2.3
112WRD - 0670830	Oakes	20	25	174	194	+25	+12	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Missouri River North Dakota Border to Big Bend Dam	1, 2, 7, 8, 9, 10, 11 (UM-CF)	Yes	NR	5

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs) -
121MBRCE - 460008	Below Oahe Dam	NR	NR	ID	ID	-	-	2845.6
112WRD - 06440000	Pierre	NR	4	ID	41500	-	-	2845.6

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Missouri River Big Bend Dam to the Iowa Border	1, 4, 7, 8, 9, 10, 11 (UM-WF)	Yes, But some question	4	4

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs) -
121MBRCE - 4600085	Below Big Bend Dam	NR	NR	ID	ID	-	-	NA
1110NET - 460032	Yankton	NR	NR	33914	33276	-	-2	4065.6
112WRD - 06469500	Yankton	2	2	33914	33276	0	-2	4065.6
121MBRCE - 460029	Yankton	NR	5	33914	33276	-	-2	4065.6

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index. 1st	Segment Index. 2nd
Cheyenne River Wyoming Border to the Angostura Dam	5, 8, 9, 10, 11 (LM-WF)	No	18	14

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
Cheyenne River 112WRD - 06395000	Edgemont	18	14	62	91	-22	+47	NA

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index. 1st	Segment Index. 2nd
Angostura Dam to the Fall River	4, 7, 8, 9, 10, 11 (LM-WF)	Probable	NR	NR

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
112WRD - 06401500	Below Angostura Res.	NR	NR	93	10	-	-808	0.40

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index. 1st	Segment Index. 2nd
Cheyenne River Fall River to the Missouri River	5, 7, 8, 9, 10, 11 (LM-WF)	Questionable	9	NR

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 0642600	Buffalo Springs	NR	NR	516	ID	-	-	NA
112WRD - 06423500	Wasta	12	ND	ID	ID	-	-	9.7
121MBRCE - 460010	Near Eagle Butte	NR	NR	ID	ID	-	-	6.5
121WRD - 06439500	Near Eagle Butte	NR	7	ID	ID	-	-	6.5

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Watercourse and segment description	State Classification (uses)	1983 goal projection			Segment Index 1st / 2nd
Big Sioux River Headwaters to the Diversion Canal at Sioux Falls	1, 5, 8, 9, 10, 11 (LM-WF)	Probable			NR / 13
		WQI	MEAN FLOW (cfs)	PERCENT CHANGE	7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st / 2nd	1st / 2nd	WQI / MEAN FLOW	-
112WRD - 064800	Brookings	NR / NR	ID / ID	- / -	1.8
112WRD - 06481000	Dell Rapids	NR / 14	ID / ID	- / -	4.0
Big Sioux River Sioux Falls Diversion Canal to Klondike Dam	5, 8, 9, 10, 11 LM WF (Semi-permanent)	Probable			NR / 22
		WQI	MEAN FLOW (cfs)	PERCENT CHANGE	7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st / 2nd	1st / 2nd	WQI / MEAN FLOW	-
1110NET - 460080	Below Sioux Falls	NR / ID	ND / ID	- / -	9.4
112WRD - 06482020	No. Cliff Road Sioux Falls	NR / 22	NR / ID	- / -	9.4
112WRD - 06482100	Brandon	NR / NR	177 / ID	- / -	9.4
Big Sioux River Klondike Dam to the Iowa Border	5, 7, 8, 9, 10, 11 (LM-NF)	Probable			NR / 33
		WQI	MEAN FLOW (cfs)	PERCENT CHANGE	7 D. 10 YR. LOW FLOW (cfs)
AGENCY-STATION	LOCATION	1st / 2nd	1st / 2nd	WQI / MEAN FLOW	-
112WRD - 0648275	Hudson	NR / 33	ID / ID	- / -	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
James River North Dakota Border to the Diversion Dam	5, 8, 9, 10, 11 (LM-WF)	Questionable	11	12

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21SDAK01 - 860805	Hecla	5	10	ID	ID	+100	-	NA
112WRD - 06471000	Columbia	NR	NR	163	35	-	-370	NA

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
James River Diversion Dam to Huron	1, 5, 8, 9, 10, 11 LM (Limited Contact) WF (Semi-permanent)	Questionable	ND	ND

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
No Stations								

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
James River Huron to the Missouri River	5, 8, 9, 10, 11 (LM-WF)	Probable	14	24

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06476000	Above Huron	12	NR	ID	ID	-	-	NA
112WRD - 06476001	At Huron WTP	23	NR	ID	ID	-	-	NA
112WRD - 06476050	Below Huron	ND	29	ID	ID	-	-	NA
112WRD - 06478000	Mitchell	NR	NR	208	67	-	-210	1.3
112WRD - 06478500	Scotland	8	11	263	163	+38	-48	1.1

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index
South Dakota Lakes Lake Oahe, Lake Frances, and Bigstone Lake	4,7,8,9,10 (UM-WF) 1,2,7,8,9,10 (UM-CF) 1,4,7,8,9,11 (UM-WF)	Probable	NR/6 NR/ND NR/NR

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
121MBRCE - 460012	Lake Oahe	NR	NR	NA	NA	-	-	NA
121MBRCE - 460002	Lake Frances Case	NR	ND	NA	NA	-	-	NA
21SDAK01 - 46BSL1	Big Stone Lake	NR	6	NA	NA	-	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Utah Lake	C (LM)	Doubtful	NR	ND

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
31UTLINK - 331302	Powell Slough	NR	ND	NA	NA	-	-	NA
31UTLINK - 331306	Pelican Point	NR	ND	NA	NA	-	-	NA
31UTLINK - 331308	Midlake West of Boat Harbor	NR	ND	NA	NA	-	-	NA
31UTLINK - 331310	N. Goshen Bay	NA	ND	NA	NA	-	-	NA

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Jordan River Utah Lake to the Utah County Line	LW (LM-WF)	Probable but depends on Utah Lake in Upper Reach	NR	14

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
21UTAH - 491501	AC Pump House	NR	NR	ID	ID	-	-	NA
31UTLINK - 331158	Bridge below lake	ND	13	ID	ID	-	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Jordan River Utah County Line to the Great Salt Lake	CC (LM-CF)	Doubtful	63	54

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
31UTLINK - 331199	Narrows	ND	41	ID	ID	-	-	NA
21UTAH - 491502	Bluffdale Road	28	16	ID	ID	-43	-	NA
21UTAH - 491505	Draper - Riverton Rd.	NR	NR	ID	ID	-	-	NA
31UTLINK - 331202	12600 S.	ND	30	ID	ID	-	-	NA
21UTAH - 491506	Above Sandy STP	47	38	ID	ID	-19	-	NA
21UTAH - 491508	Below Sandy STP	NR	NR	ID	ID	-	-	NA
21UTAH 491510	7800 S.	NR	NR	ID	ID	-	-	NA
21UTAH - 491514	Above Kearns STP	73	47	ID	ID	-36	-	NA
21UTAH - 491516	Below Kearns STP	NR	NR	ID	ID	-	-	NA
21UTAH - 491518	Above Murray STP	59	40	ID	ID	-31	-	NA
21UTAH - 491520	Below Murray STP	NR	67	ID	ID	-	-	NA
21UTAH - 491524	Above Jordan Meat	NR	NR	ID	ID	-	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Jordan River Utah County Line to the Great Salt Lake	CC (LM-CF)	Probable	63	54

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21UTAH - 491525	Below Jordan Meat	65	NR	ID	ID	-	-	NA
21UTAH - 491562	3900 S.	NR	NR	ID	ID	-	-	NA
21UTAH - 491527	Below Granger Hunter STP	NR	65	ID	ID	-	-	NA
21UTAH - 491536	2100 S.	72	66	153	171	-8	+12	NA
21UTAH - 491538	Below South Salt Lake STP	NR	NR	153	171	-	-	20.3
21UTAH - 491542	4th N.	NR	NR	153	171	-	-	NA
21UTAH - 491543	9th N.	NR	NR	153	171	-	-	NA
21UTAH - 591544	17th N.	NR	NR	ID	ID	-	-	NA
21UTAH - 491545	Cudahy Lane	64	60	ID	ID	-6	-	NA
21UTAH - 491546	Below S. Davis STP	NR	NR	ID	ID	-	-	NA
31UTLINK - 331233	Farmington Bay	ND	60	ID	ID	-	-	NA

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Utah
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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Colorado River Colorado Border to Lake Powell	CW (LM-WF)	Questionable	32	15

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 09163500	Colorado - Utah State Line	NR	NR	6753	ID	-	-	1356.7
112WRD - 09180500	Cisco (Bad Data)							1082.8
21UTAH - 491304	Moab	30	19	ID	ID	63	-	NA
21UTAH - 49306	Below Moab	NR	NR	ID	ID	35	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Bear River Headwaters to Wyoming Border	CC (LM - for Drinking CF)	Questionable	ND	ND

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
No Stations								

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Bear River Utah Back to Wyoming	CC (LM - For Drinking CF)	Questionable	ND	ND

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
No Stations								

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Bear River Idaho - Utah Border to the Great Salt Lake	CW (LM-WF)	Probable	32	18

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
112WRD - 10092200	Cornish	NR	NR	ID	ID	-	-	NA
21UTAH - 491427	Richmond	24	12	ID	ID	-50	-	NA
21UTAH - 491429	Below Cub River	NR	NR	ID	ID	-	-	NA
21UTAH - 491433	Amalga	NR	NR	ID	ID	-	-	NA
112WRD - 10126100	Bird Refuge	NR	12	ID	ID	-	-	NA

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Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Weber River Headwaters to Highway 40 at Plain City	CC LM (For Drinking) CF	Probable	21	10

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 10136500	Gateway	NR	NR	580	478	-	-18	41.1
21UTAH - 491406	Above Central Weber STP	16	10	ID	ID	-37	-	NA
21UTAH - 491408	Below Central Weber STP	NR	NR	ID	ID	-	-	NA

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Weber River Plain City to the Bird Refuge	CW (LM-WF)	No	NR	NR

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 10141100	Near Hooper South Fork	NR	NR	580	478	-	-18	NA
112WRD - 1014150	Middle Fork	NR	NR	ID	ID	-37	-	NA
112WRP - 10141200	North Fork	NR	IR	ID	ID	+50	-	NA

Utah
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Appendix 3

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Green River Flaming Gorge to the Utah Colorado Border	CC (LM-CF)	Yes	NR	7

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21UTAH - 491209	Below Flaming Gorge	NR	7	2552	3144	-	-	163.5

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Green River Colorado Utah Border to the Colorado River	CW (LM-WF)	Probable	9	11

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
21UTAH - 491211	Jensen	12	18	4706	4893	+50	+4	407.5
112WRD - 09261000	Jensen	NR	NR	4706	4893	-	+4	407.5
21UTAH - 491202	Green River, Utah	9	12	5696	5731	+33	0	617.0

Wyoming
STATE

Appendix 3

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Green River Headwater to the Flaming Gorge Res.	I (CF-WF)	Yes	NR	1

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
112WRD - 09188500	Warren Bridge	NR	NR	628	705	-	+12	66.6
112WRD - 09192600	Big Piney	NR	NR	ID	ID	-	-	NA
112WRD - 09209400	La Barge	NR	NR	1905	2078	-	+9	NA
112WRD - 09211200	Below Fontenelle	NR	NR	1728	2146	-	+24	NA
112WRD - 09317400	Green River	NR	NR	1902	2363	-	+24	287.3
112WRD - 0921700	Green River	NR	2	1902	2363	-	+24	287.3

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
Powder River Headwater to the Montana Border	I (CF-WF)	Questionable	NR	10

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
								-
112WRD - 16312500	Kaycee	NR	2	31	30	-	-3	NA
112WRD - 06317000	Arvada	NR	14	ID	ID	-	-	0.6

Wyoming
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Appendix 3

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st	Segment Index 2nd
North Platte River Colorado Border to Nebraska Border	I (CF-WF)	Questionable below Casper	12	10

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06630000	Above Seminoe Res.	NR	3	1303	1401	-	+8	95.3
112WRD - 06642000	Alcova	NR	NR	1435	1609	-	+12	1.6
112WRD - 06645000	Below Casper	15	12	1495	1933	-20	+29	362.4
112WRD - 06646800	Glenrock	NR	NR	1495	1933	-	+29	362.4
112WRD - 06652000	Orin	NR	NR	1922	1980	-	+3	381.7
112WRD - 06652800	Below Glendo Res.	NR	NR	1747	2628	-	+52	1.4
112WRD - 06656000	Below Guernsey Res.	NR	NR	1995	2743	-	+38	3.0
112WRD - 06670900	Lingle	NR	NR	1297	1636	-	+26	NA
112WRD - 06674500	Wyoming - Nebr. Border	12	10	1344	964	-9	-28	98.6

Wyoming
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Appendix 3

Watercourse and segment description	State Classification (uses)	1983 goal projection	Segment Index 1st / 2nd
Wind-Bighorn River Headwaters to the Montana Border	I (CF-WF)	Questionable	NR / 3

AGENCY-STATION	LOCATION	WQI 1st	WQI 2nd	MEAN FLOW (cfs) 1st	MEAN FLOW (cfs) 2nd	PERCENT CHANGE WQI	PERCENT CHANGE MEAN FLOW	7 D. 10 YR. LOW FLOW (cfs)
112WRD - 06218500	Dubois	NR	NR	233	192	-	-18	36.2
112WRD - 06228000	Riverton	NR	2	542	718	-	+32	61.2
112WRD - 06259000	Below Boysen	NR	NR	1600	1878	-	+17	388.7
112WRD - 06259500	Thermopolis	NR	ND	ID	ID	-	-	NA
112WRD - 06264700	Lucerne	NR	NR	ID	ID	-	-	NA
112WRD - 06268600	Worland	NR	NR	ID	ID	-	-	NA
112WRD - 06279500	Kane	NR	3	2330	2774	-	+19	299.1

APPENDIX 4

Water Quality State Standards Summary

COLORADO
WATER QUALITY STANDARDS SUMMARY

STANDARD	CLASS			
	A_1	A_2	B_1	B_2
Settleable Solids	Free From	Free From	Free From	Free From
Floating Solids	Free From	Free From	Free From	Free From
Taste, Odor, Color	Free From	Free From	Free From	Free From
Toxic Materials	Free From	Free From	Free From	Free From
Oil and Grease	Cause a film or other discoloration	Cause a film or other discoloration	Cause a film or other discoloration	Cause a film or other discoloration
Radioactive Material	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards
Fecal Coliform Bacteria Geometric Mean	<200/100ml	<200/100ml	<1000/100ml	<1000/100ml
Turbidity	No increase of more than 10 J.T.U.	No increase of more than 10 J.T.U.	No increase of more than 10 J.T.U.	No increase of more than 10 J.T.U.
Dissolved Oxygen	6 mg/l minimum	5 mg/l minimum	6 mg/l minimum	5 mg/l minimum
pH	6.5 - 8.5	6.5 - 8.5	6.0 - 9.0	6.0 - 9.0
Temperature	Maximum 68°F. Maximum Change 2°F.	Maximum 90°F. Maximum Change: Streams - 5°F. Lakes - 3°F.	Maximum 68°F. Maximum Change 2°F.	Maximum 90°F. Maximum Change: Streams - 5°F. Lakes - 3°F.

(1) Special limits for the Clark Fork
have been established.

Montana
Water Quality Standards Summary

	A-Closed	A-Open-D_1	B-D_1	B-D_2	B-D_3	C-D_1	C-D_2	E-F
Total Coliform (Average)	50/100 ml max. Total coliform	50/100 ml max. Total coliform	200/100 ml fecal 1000/100 ml Total coliform	200/100 ml fecal 100/100 ml Total coliform	200/100 ml fecal 1000/100 ml Total coliform	200/100 ml fecal 1000/100 ml Total coliform	200/100 ml fecal 1000/100 ml Total coliform	200/100 ml 1000/100 m Total coli
Dissolved Oxygen	NA	7.0 mg/1 Minimum	7.0 mg/1 Minimum	7.0 mg/1 Oct. 1 - June 1 6.0 ml/1 June 2 - Sept 30	5.0 mg/1 Minimum	7.0 mg/1 Minimum	7.0 mg/1 Oct. 1 - June 1 6.0 ml/1 June 2 - Sept 30	3.0 mg/1 Minimum
pH	No Change	6.5 - 8.5	6.5 - 8.5	6.3 - 9.0	6.5 - 9.0	6.5 - 8.5	6.5 - 9.0	6.5 - 9.5
Turbidity	No Increase	No increase	No more than 5 JTU increase	No more than 10 JTU increase	No more than 10 JTU increase	No more than 5 JTU increase	No more than 10 JTU increase	Not to inc in quantit amts which <Adversely affect the indicated
Temperature	No increase	Max. 67°F Max. change 1°F	Max. 67°F Max. change 1°F	Max. 67°F Max. change 1°F	Max. 77°F Max. change 3°F	Max. 66°F Max. change 1°F	Max. 67°F Max. change 1°F	Same as above
Settleable Solids	No increase	No increase	No increase	No increase	No increase	No increase	No increase	<Adversely affect th use indic
Sedimentation Res.	No increase	No increase	No increase	No increase	No increase	No increase	No increase	Same as above
Radioactive Material	No waste	I 131 5 pc/1 R$_a$226 1 pc/1 S-89 100 pc/1 S-90 10 pc/1 Tritium 3000 pc/1	See A-Open	See A-Open	See A-Open	See A-Open	See A-Open	See A-Open
Toxic Materials (Free From)	No increase	Drinking Water Standards	Drinking Water	Drinking Water	Drinking Water	Not to exceed levels known to be of public health significance	Not to exceed levels known to be of public health significance	<Adversely affect th use indic
Oil & Grease	No increase	Not to exceed 10 mg/1	Not to exceed 10 mg/1	Not to exceed 10 mg/1	Not to exceed 10 mg/1	Not to exceed 10 mg/1	Not to exceed 10 mg/1	Not to exc 10 mg/1
Color	NA	No increase of more than 2 units	No increase of more than 5 units	No increase of more than 5 units	No increase of more than 5 units	No increase of more than 5 units	No increase of more than 5 units	Same as above

Water Quality Standards Summary

	Class I	Class IA	Class II	Class III
Fecal Coliform Geometric Mean	200/100 ml.	200/100 ml.	200/100 ml.	1000/100 ml.
Total Coliform Geometric Mean	1000/100 ml.	1000/100 ml.	1000/100 ml.	1000/100 ml.
Dissolved Oxygen	5.0 mg/l minimum	5.0 mg/l minimum	5.0 mg/l minimum	5.0 mg/l minimum
pH	7 - 8.5	7 - 8.5	6 - 9	6 - 9
Turbidity (1)	10 JU	10 JU	25 JU	40 JU
Temperature	85°F maximum 5°F max. change	85°F maximum 5°F max. change	90°F maximum 3°F max. change	90°F maximum 3°F max. change
Color	15 units	15 units	25 units	40 units
Taste, odor	Free from	Free from	Free from	Free from
Floating Solids	Free from	Free from	Free from	Free from
Toxic Material	Free from	Free from	Free from	Free from
Oil & Grease	Not to exceed 10 mg/l	Not to exceed 10 mg/l	Not to exceed 10 mg/l	Not to exceed 10 mg/l
Iodine 131	5 pc /l	5 pc/l	5 pc/l	5 pc/l
Radium-226	1 pc /l	1 pc/l	1 pc/l	1 pc/l
Strontium-89	100 pc /l	100 pc/l	100 pc/l	100 pc/l
Strontium-90	10 pc /l	10 pc/l	10 pc/l	10 pc/l
Tritium	3000 pc /l	3000 pc/l	3000 pc/l	3000 pc/l

(1) Unless due to runoff

North Dakota
Water Quality Standards Summary

	Class I	Class IA	Class II	Class III
Ammonia	1.0 mg/1	1.5 mg/1	1.5 mg/1	2.0 mg/1
Arsenic	0.05 mg/1	0.05 mg/1	0.05 mg/1	0.1 mg/1
Barium	1.0 mg/1	1.0 mg/1	1.0 mg/1	1.0 mg/1
Baron	0.5 mg/1	0.5 mg/1	0.5 mg/1	0.75 mg/1
Cadmium	0.01 mg/1	0.01 mg/1	0.01 mg/1	0.01 mg/1
Chlorides	100 mg/1	175 mg/1	250 mg/1	250 mg/1
Chromium (hexa) or trivalent	0.05 mg/1	0.05 mg/1	0.05 mg/1	0.05 mg/1
Copper	0.05 mg/1	0.05 mg/1	0.1 mg/1	0.1 mg/1
Cyanides	0.01 mg/1	0.01 mg/1	0.01 mg/1	0.1 mg/1
Lead	0.05 mg/1	0.05 mg/1	0.05 mg/1	0.1 mg/1
Nitrates	4.0 mg/1	4.0 mg/1	5.0 mg/1	5.0 mg/1
Phenols	0.01 mg/1	0.01 mg/1	0.01 mg/1	0.01 mg/1
Phosphates (as "P")	0.1 mg/1	0.1 mg/1	0.2 mg/1	0.2 mg/1
Selenium	.01 mg/1	.01 mg/1	.01 mg/1	.01 mg/1
TDS (2)	500 mg/1	1000 mg/1	1000 mg/1	>1000 mg/1
Zinc	0.5 mg/1	0.5 mg/1	1.0 mg/1	1.0 mg/1
Sodium % of cations	50%	60%	60%	60%

(2) Unless naturally higher

South Dakota
Water Quality Standards Summary

	1	2	3	4	5	6	7	8	9	10(5-1/9-30)	11
TDS	1000 mg/1	1000 mg/1	1000 mg/1	1000 mg/1	1000 mg/1	1000 mg/1	1000/100 ml	1000 mg/1	2500 mg/1	1500 mg/1	2000/mg/1
Nitrates (as N)	10 mg/1	10 mg/1	10 mg/1	10 mg/1	10 mg/1	10 mg/1	10 mg/1	10 mg/1	50 mg/1 MNO_3	50 mg/1 as NO_3	50 mg/1 as NO_3
pH	6.0-9.0	6.6-8.6	6.5-8.8	6.5-9.0	6.3-9.0	6.0-9.0	6.5-8.3	6.0-9.0	6.0-9.5	6.0-9.5	6.0-9.5
Total coli. Geometric Mean	5000/ 100 ml	5000/ 100 ml	5000/ 100 ml	5000/ 100 ml	5000/ 100 ml	5000/ 100 ml	1000/100 ml Recreation season any sample 2000/ 100 ml	5000/100 ml Recreation season any sample 10,000/100 ml	See #8	5000/ 100 ml root crops/ rec. area	5000/ 100 ml
Fecal coli. Geometric Mean	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	Drinking Water Standards	200/100 ml recreation season any sample 400/ 100 ml	1000/100 ml recreation season any sample 2000/ 100 ml	See #8	1000/ 100 ml root crops/ rec. area	1000/ 100 ml
Chlorine Res	Free from	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1
Ammonia Nitrogen (as N)	Free from	0.06 mg/1	1.0 mg/1	1.0 mg/1	1.0 mg/1	1.5 mg/1	1.5 mg/1	1.5 mg/1	1.5 mg/1	1.5 mg/1	1.5 mg/1
Chlorides	Free from	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1	100.0 mg/1
T. Cyanide	Free from	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1	0.02 mg/1
Free Cyanide	Free from	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1	0.005 mg/1
D.O.	Drinking Water Standards	6.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1	5.0 mg/1
D.O. Spawning Season	N/A	7.0 mg/1	7.0 mg/1	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

South Dakota (Contd)
Water Quality Standards Summary

	1	2	3	4	5	6	7	8	9	10	11
H_2S (undissociated)	Free from	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l	0.002 mg/l
T. Iron	Free from	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l	0.2 mg/l
TSS	Free from	30 mg/l	90 mg/l	90 mg/l	90 mg/l	150 mg/l	150 mg/l	150 mg/l	150 mg/l	150 mg/l	150 mg/l
Temp.	Drinking Water Standards	65°F max.	75°F max.	80°F max.	90°F max.	90°F max.	90°F max.	90°F max.	90°F max.	90°F max.	90°F max.
Turbidity	Drinking Water Standards	10 J.C.U.	50 J.C.U.	50 J.C.U.	50 J.C.U.	50 J.C.U.	50 J.C.U.	50 J.C.U.	50 J.C.U.	50 J C.U.	50 J.C.U.
Conductivity									4000 micro MHO's at 25°C	2500 micro MHO's at 25°C	2500 micro MHO's at 25°C
Sodium abs. ratio										10	
Alkalinity (as C_aCO_3)									750 mg/l		

NOTES - SOUTH DAKOTA

For All Classifications

A. Radioactive Material

Iodine - 131 - 5 pc/l
Radium - 226 - 1 pc/l
Strontium - 89 - 100 pc/l
Strontium - 90 - 10 pc/l
Tritium - 300 pc/l

B. Toxic Materials Above Standard

Allowed for certain beneficial purposes if no danger to health

C. Petroleum Products

No materials of petroleum derivation shall be discharged which results in concentration of excess of 10 mg/l or imparts of visible film or sheen

D. Gas Pressure

Less than 110% of saturation.

Utah
Water Quality Standards Summary

	"A"	"B"	"C"	"CC"	"CW"	"CR"	"CCR"	"CWR"	"D"	"E"	"S"
Total coliform Average	Drinking Water Standards	50/100 ml	5000/100 ml	See C	See C	1000/100 ml	See C	See C	5000/100 ml	There shall be no discharge of any waste into Class "E" waters	Same as Class "A" except for specific waste discharges permitted by Committee and Board
Fecal coliform	Drinking Water Standards	See A	See A Except Biological Water Std's	See C	See C	See C	See C	See C	See C		
B.O.D.	Free from	See A	5 mg/l	See C	See C	See C	See C	See C	25 mg/l		
D.O.	Drinking Water Standards	See A	5.5 mg/l	6.0 mg/l	See C	See C	See C	See C	See A		
pH.	6.5-8.5	6.5-8.5	6.5-8.5	6.5-8.5	See C	See C	See C	See C	6.5-9.0		
Temp.	Suitable for intended use	See A	See A	68°F max 2°F change	80°F max 4°F change	See A	68°F max 2°F change	80°F max 4°F change	None Added		
Chemical Standards	Drinking Water Standards	See A	See A	See A	See A	See A	See A	See A	See A		
Physical Standards	Drinking Water Standards	See A	See A	See A	See A	See A	See A	See A	See A		
Radiological Standards	1/30th of MPCW Values	See A	See A	See A	See A	See A	See A	See A	See A		
Settleable Solids	Free from	See A	See A	See A	See A	See A	See A	See A	See A		
Floating Solids	Free from	See A	See A	See A	See A	See A	See A	See A	See A		

Wyoming
Water Quality Standard Summary

	I	II	III
Fecal Coliform Geometric Mean	*May 1 thru Sept. 30 200/100 ml primary contact 1000/100 ml secondary contact	**May 1 thru Sept. 30 1000#/1 secondary contact	None
Total Coliform	None	None	None
D.O.	6.0 mg/1	5.0 mg/1	None
Floating Solids	Free from	Free from	Free from
Oil & Grease	10 mg/1 max.	10 mg/1	10 mg/1
pH	6.5 - 8.5	6.5 - 8.5	6.5 - 8.5
Radioactive Material	BPT	BPT	BPT
a. Radium - 226 b. Strontium - 90	3 pc/1 10 pc/1		
Salinity	--	--	Under study
Settleable Solids	Free from	Free from	Free from
Taste, Odor, and Color	Free from	Free from	None
Temperature	Warm water 90°F (max) Cold water 78°F (max.) 2°/4° max. increase	Warm water 90°F (max.) Cold water 78°F (max.) 2°/4° max. increase	None
Toxic Material	Free from	Free from	Free from
Turbidity	Increase of 10 JTU max.	Increase of 10 JTU max.	None
Total Gas Pressure	110% of Atmosphere	110% of Atmosphere	110% of Atmosphere

* Applies to still water below 7000 feet and certain other streams.

** Applies to all other waters not in I.